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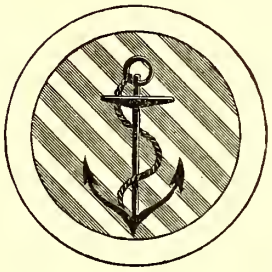
Measurement of Vessels for the Panama Canal

By

EMORY R. JOHNSON

Special Commissioner on Panama Canal
Traffic and Tolls



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LETTER OF SUBMITTAL.

WASHINGTON, D. C., *October 2, 1913.*

SIR: I have the honor to submit herewith a report upon the Measurement of Vessels for the Panama Canal. The report is made pursuant to instructions received from the Secretary of War, September 1, 1911, "to formulate rules and regulations governing the measurement of ships going through the canal, and to make an investigation and recommendation regarding the tolls to be charged."

A report upon Panama Canal Traffic and Tolls was submitted to the Secretary of War, August 7, 1912, and the rates of toll recommended in that report were established by a proclamation of the President, issued November 13, 1912. The proclamation fixing tolls also announced that "The Secretary of War will prepare and prescribe such rules for the measurement of vessels and such regulations as may be necessary and proper to carry this proclamation into full force and effect."

The report herewith submitted considers in detail the problems of tonnage and vessel measurement, and contains a set of rules which it is recommended be followed in determining the tonnage upon which Panama Canal tolls shall be paid. The principles upon which the rules are based are discussed in the report, and reasons are given for each of the main provisions contained in the code of rules recommended. The introductory chapter presents a short summary of the report and the concluding chapter contains a brief explanation of the main features of the proposed Panama measurement rules.

In preparing this report I have been greatly aided by my assistant, Grover G. Huebner, Ph. D., of the University of Pennsylvania, whose cooperation has made possible the collection, analysis, and presentation of much of the detail embodied in the report.

My thanks are due to Chief Constructor Richard Morgan Watt and other officers of the Bureau of Construction and Repair Department of the Navy, who have cooperated in drafting the rules to determine the tonnage upon which warships shall pay tolls; and I am also indebted to Mr. James H. Mancor, Principal Surveyor, United States and Canada, for Lloyd's Register of Shipping, and to Mr. Hugo P. Frear, Naval Architect, to both of whom the proposed measurement rules were submitted for criticism.

Very respectfully,

EMORY R. JOHNSON,
Special Commissioner on Panama Canal Traffic and Tolls.

The SECRETARY OF WAR.

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PART I.

TONNAGE AND MEASUREMENT RULES.

CHAPTER I.

INTRODUCTION—SCOPE OF THE REPORT.

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INTRODUCTION—SCOPE OF THE REPORT.

By proclamation, issued November 13, 1912, the President of the United States, acting upon the authority given him by the act of Congress approved August 24, 1912, prescribed the following schedule of tolls to be paid by vessels using the Panama Canal:

1. On merchant vessels carrying passengers or cargo one dollar and twenty cents ($1.20) per net vessel ton—each one hundred (100) cubic feet—of actual earning capacity.

2. On vessels in ballast, without passengers or cargo, forty (40) per cent less than the rate of tolls for vessels with passengers or cargo.

3. Upon naval vessels, other than transports, colliers, hospital ships, and supply ships, fifty (50) cents per displacement ton.

4. Upon Army and Navy transports, colliers, hospital ships, and supply ships one dollar and twenty cents ($1.20) per net ton, the vessels to be measured by the same rules as are employed in determining the net tonnage of merchant vessels.

By the act of August 24, 1912, Congress provided that—

> Tolls may be based upon gross or net registered tonnage, displacement tonnage, or otherwise, and may be based on one form of tonnage for warships and another for ships of commerce. The rate of tolls may be lower upon vessels in ballast than upon vessels carrying passengers or cargo. When based upon net registered tonnage for ships of commerce the tolls shall not exceed $1.25 per net registered ton, nor be less, other than for vessels of the United States and its citizens, than the estimated proportionate cost of the actual maintenance and operation of the canal, subject, however, to the provisions of article nineteen of the convention between the United States and the Republic of Panama, entered into November eighteenth, nineteen hundred and three. If the tolls shall not be based upon net registered tonnage they shall not exceed the equivalent of $1.25 per net registered ton as nearly as the same may be determined, nor be less than the equivalent of 75 cents per net registered ton. The toll for each passenger shall not be more than $1.50. The President is authorized to make, and from time to time amend, regulations governing the operation of the Panama Canal, and the passage and control of vessels through the same or any part thereof, including the locks and approaches thereto, and all rules and regulations affecting pilots and pilotage in the canal or the approaches thereto through the adjacent waters.

In his proclamation of November 13, 1912, the President directed the Secretary of War to "prepare and prescribe such rules for the measurement of vessels and such regulations as may be necessary to carry this proclamation into full force and effect."

The primary purpose of this report is to present the facts to be considered in formulating rules for the measurement of vessels and to recommend a set of rules to be followed in determining the tonnage upon which vessels using the Panama Canal shall pay tolls. The report includes a code of Panama measurement rules and a form of certificate to be issued to vessels measured for Panama Canal tonnage. The report is intended to explain the rules fully and to afford a guide to those whose duty it shall be to apply and interpret the rules. It is expected that the report will be consulted by the officials, American and foreign, who measure vessels and issue Panama tonnage certificates, by the administrative officials who pass upon those certificates when presented at the Panama Canal, and by those judges who may have to decide cases involving the interpretation that Panama Canal officials have given the rules. To carry out this purpose more effectively, an effort has been made so to write the report that it may readily be understood by those who do not have a technical knowledge of tonnage questions.

Rules for the measurement of vessels must, if possible, be so framed as to be readily and accurately applicable to the vessels that are to be measured. The rules must fit the ships, and

ocean vessels of to-day are complicated structures of many types and designs. It thus seemed clear that this report upon the measurement of vessels ought to begin, as it does, with a brief illustrative description of the main types of ships whose tonnage will be determined by the rules to be formulated.

The words "ton" and "tonnage" have so many meanings that it is difficult, even for the technical man, to use the terms with strict accuracy. It is necessary, first of all, in framing rules for the determination of the tonnage upon which Panama Canal charges shall be imposed, to decide which kind of ton shall be made the basis or unit of the charges. The report in Part I explains the different kinds of tons and analyzes the provisions of the rules by which the United States, Great Britain, Germany, and the Suez Canal Co. determine the gross and net tonnage of vessels. This survey and analysis of the vessel-measurement rules of three important commerical countries and of the company operating the interoceanic waterway most comparable with the Panama Canal brings out the merits and defects of existing tonnage rules and makes clear what should be the main provisions of the Panama measurement code. Subsequent chapters of the report discuss the principles that should control in framing rules to determine the tonnage upon which vessel charges should be imposed. The report, as a whole, may thus be regarded as a treatise on tonnage and vessel measurement prepared with reference to framing rules to apply in determining the tonnage upon which Panama Canal charges shall be imposed.

The question is often asked why charges for the use of ocean-ship canals, such as the Suez, Kiel, and Panama Canals, are imposed upon the tonnage of vessels instead of upon the tonnage of the cargo carried by the vessels. The report seeks to explain why the capacity of merchant vessels for the accommodation of passengers and the stowage of cargo, rather than the cargo and passengers carried, is the more equitable and more practicable basis of canal charges; and the report also states the reasons why warships should pay tolls upon their weight or displacement tonnage, and not upon the kind of tonnage that is made the basis of charges upon vessels of commerce.

The President's proclamation fixing Panama Canal tolls makes displacement tonnage the basis of the charges upon warships, while the dues payable by vessels of commerce are to be imposed upon the earning capacity of ships. The Suez Canal Co. does not make this distinction between warships and merchant vessels, but levies tolls upon the net tonnage of vessels of war as well as of vessels of commerce. The application of the Suez, or other, measurement rules to warships can, however, result only in an artificial net or capacity tonnage that but roughly indicates the size of different classes of war vessels. In fact, rules for the determination of the gross and net tonnage of merchant vessels are not applicable to warships. Warships are fighting machines that have no earning capacity and can have no real net tonnage. The size of vessels of war is more accurately indicated by their weight, or displacement, than by the capacity of their inclosed spaces. It may be otherwise with vessels that serve armed ships. Army and Navy transports, colliers, supply ships, and hospital ships are structurally similar to merchant vessels, and may, without much difficulty, be measured by rules applicable to passenger and freight carriers. Such auxiliary vessels of war may be readily and equitably charged tolls upon their net capacity or net tonnage, but charges upon fighting ships ought, for reasons that are set forth in the report, to be levied upon their displacement tonnage.

The charges required of a vessel of commerce for the use of the Panama Canal might theoretically be either upon the tonnage of the ship or upon the tons of cargo in the vessel; and, in either case, there might also be a toll charged upon each passenger carried. If the tolls were imposed upon the cargo, the charge might be upon the tons of the commodities in the ship without regard to differences in the kinds and values of the articles carried, or the tolls upon the cargo might, like railroad rates, be made to vary with commodities or with classes of articles. As a matter of fact, tolls upon cargo or upon commodities and classes of articles

are administratively impracticable. Fortunately, it is not necessary to make cargo the basis of canal tolls in order to realize equity in canal charges.

If the canal tolls and other charges payable by merchant vessels are levied upon the ship and not upon the cargo carried, the charges may be either upon the weight of the ship or upon the size, or closed-in capacity, of the vessel. If the charges are placed upon the weight of the vessel—the displacement tonnage—the weight taken as the basis of the tolls would be the weight of the ship and its load.

Tolls might also be levied upon the difference between the weight of vessels when loaded and when "light." In the latter case, the tolls would be levied upon the vessel's carrying ability or its "dead-weight capacity."

If the canal charges are made such as to tax vessels of commerce according to their size or closed-in capacity, the charges may be upon the entire capacity of the vessel or upon only the closed-in space available for the stowage of cargo and stores and for the accommodation of passengers. The entire closed-in capacity of a ship, in units of 100 cubic feet, is its gross tonnage. The capacity of a vessel, in units of 100 cubit feet, for the transportation of cargo, and passengers is the vessel's net tonnage.

In the report made in 1912 upon "Panama Canal Traffic and Tolls," the possible bases upon which the charges for the use of the Panama Canal might be imposed were necessarily considered in a preliminary way; and it was recommended that the tolls payable by merchant vessels should be imposed upon their earning capacity, and that charges upon warships should be levied upon their displacement. The reasons for those conclusions are presented at length in the following report; and the rules for the measurement of vessels, other than warships, have been so drafted that the net tonnage of vessels, as determined by the rules, will be as exact an expression as it is practicable to obtain of the capacity of vessels—which are of many types and designs—for the stowage of cargo and for the accommodation of passengers.

It was necessary to have a special set of rules for the measurement of vessels of commerce to determine the tonnage upon which Panama Canal tolls shall be paid. The adoption of the rules followed by the United States in measuring vessels for registry was inadvisable; and none of the national vessel measurement rules of foreign countries would have met the requirements. The Suez Canal Co.'s tonnage rules, having been formulated by an international tonnage commission with a view to establishing an equitable basis upon which to impose the charges for the use of a great interoceanic waterway, are more nearly like the rules required for the Panama Canal than is any one of the national measurement codes; but the Suez rules, drafted 40 years ago, contain some provisions that ought not to be included in the Panama rules. The detailed analysis, in this report, of the measurements rules of the United States, Great Britain, Germany, and the Suez Canal Co. makes clear why special Panama measurement rules are necessary. The main reasons why it is not advisable to adopt for the Panama Canal one of the existing measurement codes may be briefly summarized:

None of the national measurement rules, neither those of the United States nor those of foreign countries, is framed with a view to making registered tonnage an accurate expression of the earning capacity of vessels. If any one of these sets of rules were adopted to determine the tonnage upon which Panama Canal charges shall be paid, the charges would not be relatively fair as among different types of ships, tolls would not be imposed as closely as is desirable in accordance with the ability of vessels to pay the charges, and the Government might be deprived of a portion of the revenues which it would be justly entitled to receive for the service of passing ships through the canal.

Still less would it be possible to accept as the tonnage upon which Panama Canal charges shall be paid the tonnage of vessels as stated in their respective national certificates of registry. The measurement rules in force in the several commercial countries differ in important particulars both as regards the spaces included in gross tonnage and as regards the deductions made therefrom in determining the net tonnage upon which shipping charges are imposed.

There is, as the report shows, a surprising variation in gross tonnage given the same vessel when measured by different rules, and there is even greater dissimilarity in the net tonnage of vessels as determined by different measurement rules. In some countries the net tonnage of vessels composing the merchant marine averages only 61 per cent of the gross tonnage, while in other countries the average is over 70 per cent; or, stated differently, some countries in calculating net tonnage deduct 39 per cent and other countries less than 30 per cent of the space included in gross tonnage. Each country, some more zealously than others, seeks, by means of its laws and regulations concerning gross and net tonnage, to lighten the burdens to be borne by the vessels under its flag as compared with the shipping under other ensigns. In framing rules for the measurement of vessels for national registry, commercial countries do not seek to make net tonnage what it should be made by the Panama rules—the closest practicable approximation of the earning capacity of vessels of different types.

If it were advisable to adopt for the determination of Panama Canal tonnage one of the measurement codes now in force, the British rules should receive consideration, for the reason that nearly half of all the ships on the high seas are of British registry and thus carry British tonnage certificates. The British rules, however, make both the gross and net tonnage of most vessels especially low and do not apply with equal fairness to ships of different types. If the British rules were correct in basic principles and in their main provisions, it might be well to make them the Panama rules, provided Great Britain would agree not to change her measurement rules except upon joint action taken by Great Britain and the United States to amend simultaneously the common British and Panama rules. Possibly neither country would favor such an arrangement. Indeed there seems more prospect of the ultimate unification of tonnage and measurement rules by harmonizing the Suez and Panama codes and making them the basis of international tonnage uniformity.

The Suez measurement rules are based upon correct general principles—that gross tonnage should include and express the total capacity of vessels, and net tonnage the capacity available for passengers and cargo—but in various provisions of the rules these principles are not closely followed. As is explained in this report the Suez rules are not logical in their treatment of double-bottom spaces and of ballast tanks; nor are the provisions satisfactory regarding the measurement and exemption of spaces in superstructures. The most serious objection to the Suez rules is that the deductions from gross tonnage allowable for crew and navigation spaces—all deductions other than for propelling machinery and fuel—are limited to 5 per cent of the gross tonnage. Such a limitation may have been justifiable in 1873 when the Suez rules were framed by the International Tonnage Commission, but any such restriction upon crew and navigation spaces would be indefensible in rules drafted at the present time.

In formulating measurement rules to carry out the general principles that gross tonnage should be the equivalent of the entire closed-in capacity, and net tonnage of the earning capacity, of vessels, there were, in addition to many questions of lesser importance, two large problems requiring careful solution. These were (1) the treatment to be accorded spaces above what is usually called the upper deck of vessels, and (2) the deductions to be allowed for propelling machinery and fuel. Upon the provisions concerning the measurement or exemption of the spaces between the "upper" deck and the deck above—usually called the "shelter" deck—and of the spaces within the superstructures (the poop, forecastle, bridge, etc.) depends, most of all, the correctness of the gross tonnage accorded vessels; while the rule followed in making deductions for propelling machinery and fuel does most to determine the accuracy of net tonnage as an expression of the earning capacity of vessels.

Gross tonnage, as determined by the measurement rules of Great Britain and of Germany and such other countries as have gross tonnage rules like the British, is, for most freight vessels of recent construction, less than the tonnage according to the rules of the Suez Canal Co. or the rules followed by the United States in measuring ships for registry. The same vessel may have as much as 20 per cent less gross tonnage when measured by the British or German rules

than when measured in accordance with the Suez or American rules. While this is an extreme variation, vessels often vary as much as 10 per cent in gross tonnage when measured by different rules.

This is due partly to the fact that the rules of the Suez Canal Co. and of the United States measure certain superstructure spaces which the British and German rules exempt from measurement, but the variations in gross tonnage result mainly from the exemption by the British and German rules, and the measurement under the Suez and American rules, of the spaces between the uppermost full-length deck—which is called the "shelter" deck—and the deck next below, which is usually called the "upper" deck. Under a decision rendered in 1875 by the House of Lords, British admeasurers must exempt from measurement and gross tonnage the between-deck space under the "shelter" deck when that deck has a "tonnage opening," and when the bulkheads subdividing the between-deck space has the openings stipulated in the Board of Trade regulations. The "tonnage opening" by which exemption from measurement is secured for the large between-deck space is in reality a technical opening which can be so covered when the vessel is at sea as to protect the space under the "shelter" deck from the weather and the sea. Dry cargo can be, and is, carried in the between-deck space under the "shelter" deck. The Suez rules, and usually the American rules, include the space within gross tonnage. The Panama rules follow the Suez regulations in considering as closed-in, and thus to be included in gross tonnage, the space under so-called shelter decks. A history and criticism of existing rules concerning the measurement and exemption of spaces in superstructures and under "shelter" decks is presented in Chapter XI of the report.

The larger part of the deduction made from gross tonnage to ascertain net tonnage is for the spaces occupied by propelling machinery and fuel. Under the Suez rules, deductions other than for power and fuel may amount to only 5 per cent of the gross tonnage. There are three rules or methods by which the space to be deducted for propelling machinery and fuel is determined.

One method is to measure the space actually occupied by the engine and boiler rooms (including designated portions of the spaces framed in around the funnels and for the admission of light and air to those rooms), by the shaft trunks or tunnels (in the case of screw-propelled vessels), and by the fixed bunkers or compartments set aside for fuel. This method is not readily applicable to vessels that have coal bunkers with movable partitions.

Another method of making propelling-power deduction is to allow for the space occupied by machinery and fuel a fixed percentage of the entire space included in gross tonnage. For most vessels—i. e., for vessels having screw propellers and having propelling-machinery spaces comprising more than 13 and less than 20 per cent of the space included in gross tonnage—the British rules allow a deduction for propelling power and for fuel of 32 per cent of the gross tonnage. The adherence of Great Britain to this percentage rule has caused most other countries to adopt the rule.

A third method of determining the space to be deducted for propelling machinery and fuel is to assume a percentage relationship between machinery and fuel spaces and to deduct for power and fuel the space occupied by propelling machinery increased by a fixed percentage. This is the method followed in the "Danube rule," which calls for the measurement of the spaces occupied by the engine and boiler rooms, including designated portions of the framed-in light-and-air and funnel spaces, and, in the case of screw-propelled vessels, of the shaft trunk or trunks. To the volume of the machinery spaces thus measured, there is added, to allow for fuel, 75 per cent for vessels with screws and 50 per cent for ships with paddle wheels. This method of making propelling-power deductions is equally applicable to vessels with or without fixed fuel compartments. The measurement rules of the European Commission of the Danube and those of the Suez Canal Co. follow the Danube rule in making propelling-power deductions; and give vessel owners the alternative, in the case of vessels having fixed fuel compartments, of having the spaces deducted that are actually occupied by or set aside for fuel bunkers or tanks and by propelling machinery.

The major share of ocean vessels consists of freight steamers, and most freight vessels are so constructed that the engine and boiler rooms (including shaft trunks and air and funnel spaces) occupy spaces equal to slightly more than 13 per cent of the space included in gross tonnage. If the propelling machinery spaces in a freight steamer occupied 13.2 per cent of the gross tonnage, the deduction for machinery and fuel under the Danube rule would be 23.1 (13.2×1.75) per cent and under the British percentage rule 32 per cent. In the case of an average-sized modern freight steamer of 6,000 tons gross tonnage, the propelling power deduction under the percentage rule would, if the engine room occupied 13.2 per cent of the space included in gross tonnage, be 534 tons more than under the Danube rule.

The deductions allowed for fuel spaces by the Danube rule are liberal, experience showing that vessel owners seldom prefer to have deductions made by the actual measurement of fuel spaces. The Panama rules, for reasons given in detail in this report, have adopted with slight modification the rule for propelling power deductions contained in the measurement codes of the European Commission of the Danube and of the Suez Canal Co.—i. e., the Danube rule with the alternative of the actual measurement of spaces occupied by fixed bunkers or fuel tanks. Chapter IX of the report contains a history and criticism of rules concerning deductions for propelling power.

During recent years numerous ocean vessels have been equipped with internal-combustion engines. Such engines are of different kinds, some of which occupy less space than is required by steam engines of like power, while all types of internal-combustion engines consume less fuel than do steam engines of equal power. It was necessary to decide whether the same rule as to propelling power deduction should be applied to vessels having internal-combustion engines as to vessels equipped with steam machinery. The question is discussed with some detail in Chapter X upon propelling power deductions for vessels equipped with oil and gas engines. It was decided that the development of marine internal-combustion engines had not yet proceeded far enough to warrant the application to vessels equipped with such engines of a special rule, for propelling power deduction, different from the rule applied to other vessels.

Vessels will be measured for Panama tonnage certificates, not only by American admeasurers at the several ports of the United States but also, and much more largely, by foreign admeasurers at foreign ports. In order to insure the fair treatment of all vessels and to protect the Panama Canal revenues against losses, it is important that admeasurers the world over shall give the Panama rules the same interpretation. To assist in bringing this about, the measurement rules have been made as definite and specific as possible, and the final chapter of the report is devoted to a brief explanation of the main features of the rules.

The Suez Canal Co. and the governments whose officials measure vessels for Suez tonnage certificates have found it advisable to issue special directions for the guidance of admeasurers. In the documents appended to this report will be found the instructions of the British Board of Trade to surveyors who measure vessels for Suez Canal tonnage; also the instructions of the German Government for the application of the Suez rules; and the memorandum of the Suez Canal Co. on the application of the rules of 1904 relative to the measurement of superstructures.

It is hoped that it may not be necessary either for the Panama Canal administration or for the vessel measurement authorities of foreign countries to issue special instructions for the guidance of admeasurers in applying the Panama rules and in issuing Panama tonnage certificates. Should, however, experience in the application of the rules show the necessity for special instructions for the guidance of admeasurers, the discussion of the rules contained in the report should make the preparation of such instructions comparatively easy.

It has long been realized that the international unification of vessel measurement rules would be of advantage to commerce and shipping. Uniformity in rules and in measurement practice would give a common meaning to tonnage as stated in the certificates of vessels under all flags, and the owners of vessels would not be burdened with the expense and possible delays connected with any measurement subsequent to that necessarily given ships at the time of their registry by the country whose flag they carry. Each vessel's tonnage as stated in its

certificate of registry could be accepted at all canals in collecting tolls and at all ports as a basis for tonnage taxes, towage, dockage, and other port charges.

Any ship using the Suez Canal must carry both its national registry certificate and a Suez tonnage certificate. The use of the Panama Canal will require another certificate. This requirement is, however, of minor consequence as compared with other results of the lack of international uniformity in measurement rules. If the tonnage of a vessel as stated in the national certificate is not accepted by the authorities of the foreign port entered by the ship and admeasurerers make additions to the vessel's tonnage, delays, bickerings, and appeals by the vessel's owners from decisions of the surveyor of the port may result; while, if the tonnage of registry is accepted without correction, the charges imposed upon shipping may be unfair as between different types of vessels, unjust as between the owners of vessels and the owners of docks, wharves, and other port facilities, and inequitable as between the different countries to which tonnage or "light dues" are paid.

These disadvantages are to some extent, but only partly, overcome by agreements among the leading commercial countries to accept at each other's ports tonnage figures as stated in national certificates. When the tonnage of a vessel is much less than it would be under the laws of the country of a port the vessel may enter, it is usual for the measurement authorities to measure, and add to the tonnage, spaces that were exempted in measuring the vessel for registry. American admeasurers, for example, frequently make additions to the registered tonnage of British, German, and French vessels. This is done because our navigation laws include in the gross tonnage of some vessels spaces in superstructures and under the so-called "shelter" deck that may be exempted from measurement under the rules of Great Britain and Germany.

The desirability of unifying measurement rules was brought to the attention of the commercial powers of Europe as early as 1861 by the European Commission of the Danube—an international body that had been given charge, in 1856, of the improvement of the navigation of the mouth and lower course of the Danube River and had been given authority to collect tolls to meet the expenses of the improvements. This suggestion of the Commission of the Danube was followed in 1862 by a memorandum, prepared by the British Board of Trade, "pointing out the importance of the uniform system of tonnage measurement." This memorandum was submitted by the British foreign office to the French Government and negotiations followed, which, however, did not lead to any definite results before 1870, when the troublous decade of the sixties culminated in the Franco-Prussian War, which temporarily brought commercial negotiations to an end.

It was thought that the opening of the Suez Canal in the latter part of 1869 might lead to the international unification of tonnage rules. A commission appointed in 1868 by de Lesseps to consider questions connected with the operation of the Suez Canal recommended that charges for the use of the canal should be levied upon the tonnage stated in each vessel's official papers (its net register tonnage) until uniform rules had been adopted by the maritime powers. The international unification of rules did not follow as expected. Moreover, the Suez Canal Co., finding that its revenues were inadequate to meet its capital charges, decided to collect tolls from July 1, 1872, upon the gross instead of the net tonnage of vessels. The opposition which this aroused on the part of the shipping interests and of the commercial countries of Europe led to the convening by the Sultan of Turkey of the International Tonnage Commission, which met at Constantinople in September, 1873. The international commission, though convened primarily to decide what tonnage should be the basis of Suez tolls and what rate of charges the Suez Canal Co. should impose, considered, and the following December reported upon, the "question of tonnage generally." It drafted rules which it expected would be adopted not only by the Suez Canal Co. but also by the maritime countries represented at Constantinople.

As is explained in Chapter XII of this report, which discusses the past efforts for, and the future possibilities of, international uniformity in tonnage and measurement, it is probable that the expectation of the International Tonnage Commission of 1873 would have been realized had

not the efforts made by the British Board of Trade in 1874 and again in 1881 to secure the adoption by Parliament of the measurement rules framed at Constantinople been defeated by the opposition of the shipowners of Great Britain, who objected to the increase that would be made in the net tonnage of vessels—the tonnage upon which shipping charges of most kinds are levied.

The opening of the Panama Canal might well be made the occasion of another earnest effort to secure the unification of tonnage rules. The Panama rules and those framed for the Suez Canal Co. by the International Tonnage Commission are based upon sound principles common to both sets of rules. It would not seem impossible for the leading commercial countries to agree upon a single code of measurement rules carrying out the principles that underly the Panama and Suez rules and embodying the essential provisions common to those two codes. If that were done, there ought to be no great difficulty in harmonizing the minor differences in the Panama and Suez rules and in making the rules thus harmonized the single measurement code of the world.

CHAPTER II.

TYPES OF VESSELS DISTINGUISHED AND ILLUSTRATED.

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Throughout the discussion of the measurement of vessels it is necessary to refer to different types of ships and to the structural parts of vessels. Frequent mention must also be made of the many spaces into which vessels are divided. Inasmuch as technical terms are used, which, though familiar to shipbuilders and seafaring men, are not a part of the vocabulary of those not connected with ships and shipping, it will be well to distinguish and illustrate the main types of ocean vessels and designate and locate both the main structural parts and the principal spaces within such ships.

It is desirable that this report and the measurement rules it contains should be understood by lawmakers and courts as well as by the technical officials who may apply and enforce the measurement rules. The rules may have to be interpreted by the courts from time to time in deciding cases brought by complainants appealing from decisions of the executive officers in charge of the interpretation and enforcement of the rules. It is also possible that vessel measurement may be the subject of future legislation. Congress has authorized the President to prescribe and to change the Panama rules, but the rules by which American vessels are measured for registration and enrollment and by which all ships entering the ports of the United States are, or may be, measured for the imposition of tonnage taxes are established by law. Moreover, the existing national rules, as will be pointed out in the following report, are incomplete in some particulars and not sufficiently specific in other regards. It has seemed best to run the risk of seeming to some readers to be unnecessarily elementary, and to prepare this report with a view to making its contents clear to the layman as well as to the engineer and the nautical expert.

An ocean vessel's type is indicated by the number of its decks, by the characteristics of its structures above the main deck, by the fuel it uses, and by the kind of engines and the number of propellers with which it is equipped. There are many variations in the structural details of vessels, but the main types of ships may be designated by reference to the number of their decks, the nature of their decks, their above-deck structures, their fuel, and their engines and propellers.

Small freight vessels have two decks, medium-sized freight and passenger ships have three decks, while large freight vessels and those carrying both freight and passengers usually have four full decks, above which there may be one or more decks extending less than the full length of the vessel and inclosing successive tiers of superstructures. In vessels having more than one deck, the main deck (which, in measurement rules, is also called the tonnage deck) is the second deck from the bottom of the vessel. When there are three decks they are designated lower, main (or middle), and upper deck. If there are four full decks, the fourth deck is generally called the shelter deck, above which there may be a bridge deck and a promenade deck, or bridge, promenade, and boats decks. The decks above the shelter deck do not extend the full length of the hull. The sketches (Figs. 1, 2, 3, and 4) of half midship sections of vessels name and locate the several decks.

The strength of a vessel depends, first of all, upon the weight and strength of its transverse framing, consisting of the floors and frames (see Fig. 3) to which the plates inclosing the hull are riveted. The minimum size of frames for different types of vessels is prescribed by the rules established by Lloyd's Association and similar organizations which classify vessels and

give them the rating upon which insurance rates depend. The transverse frames are placed from 24 to 30 inches apart and the framing may be strengthened in various ways: (1) By "deep framing," i. e., by making the transverse frames deeper and stronger; (2) by substituting web frames or beams for each sixth to tenth transverse frame; and (3) by increasing the number and dimensions of the longitudinal beams or stringers that give longitudinal strength to the vessel.

Practically every vessel is now constructed with a double bottom, the space between the inner and outer plating being used to carry water ballast. Certain compartments may be

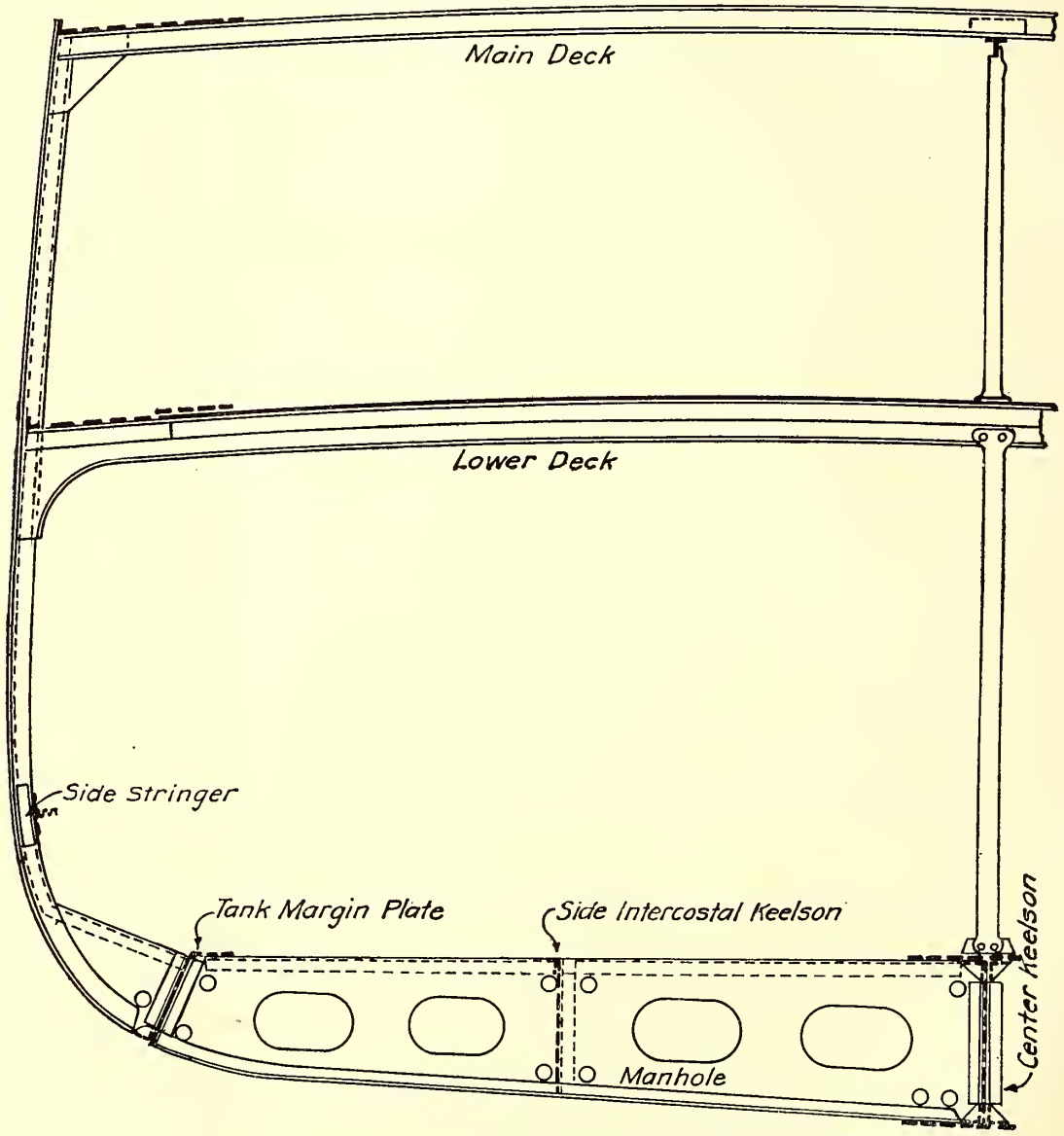
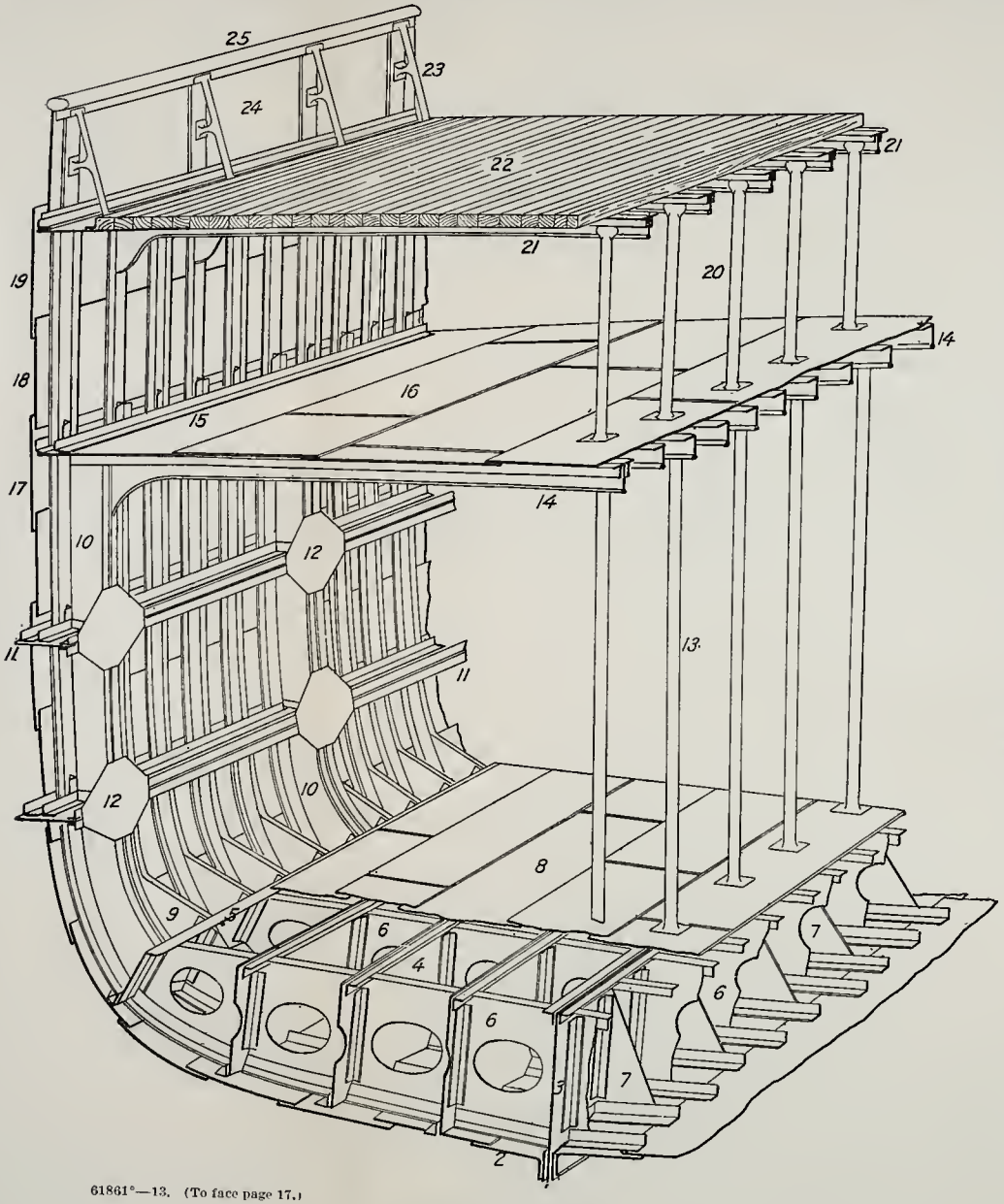


FIGURE 1.—Midship section, showing beams and pillars for lower and main decks.

used to carry fresh water for the boilers, and in the case of ships with oil-burning engines a portion of the tank space in the double bottom may be used to store fuel oil. The particular use to which the double-bottom compartments are devoted is an important consideration in vessel measurement and is the subject of special mention in all codes of tonnage rules.

The prevailing method of constructing the double bottom of vessels is illustrated in figures 3 and 11. It is called the cellular double bottom. The floors, which are the transverse steel plates extending from the center longitudinal girder (keelson) to the margin plate or longi-

FIG. 3. MIDSHIP SECTION OF WEB FRAME STEAMER HAVING CELLULAR DOUBLE-BOTTOM, LOWER DECK DISPENSED WITH.



1 Keel; Side bar keel
2 Garboard; Garboard strake.
3 Center girder; Vertical center plate; Center through plate keel and keelson.
4 Side girders
5 Wing girder; Margin plate.
6 Floors; Intercostal floors.
7 Brackets.
8 Inner bottom; Top of double bottom; Top of tank.
9 Bracket frames.
10 Web frames.
11 Side stringers.
12 Diamond plates
13 Hold pillars, Hold stanchions.
14 Main deck beams.
15 Main deck stringer.
16 Main deck plating
17 Main deck sheerstrake.
18 Topside strake
19 Upper deck sheerstrake.
20 Upper deck pillars; Upper deck stanchions.
21 Upper deck beams.
22 Upper deck.
23 Bulwark stay.
24 Bulwark plating.
25 Main rail; Roughtree rail.

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)OUBLE-BOTTOM, LOWER DECK DISPENSED WITH.

1 Keel; Side bar keel
2 Garboard; Garboard strake.
3 Center girder; Vertical center plate; Center through plate keel and keelson.
4 Side girders.
5 Wing girder; Margin plate.
6 Floors; Intercostal floors.
7 Brackets.
8 Inner bottom; Top of double bottom; Top of tank.
9 Bracket frames.
10 Web frames.
11 Side stringers.
12 Diamond plates
13 Hold. pillars, Hold stanchions.
14 Main deck beams.
15 Main deck stringer.
16 Main deck plating.
17 Main deck sheerstrake.
18 Topside strake
19 Upper deck sheerstrake.
20 Upper deck pillars; Upper deck stanchions.
21 Upper deck beams.
22 Upper deck.
23 Bulwark stay.
24 Bulwark plating.
25 Main rail; Roughtree rail.

tudinal wing girder at the upward bend of the frames, are crossed at right angles by the longitudinal side girders that parallel the keelson. The floors may be continuous from keelson to margin plate and the side girders intercostal between the floors; or, as in figure 3, the longitudinal girders may be continuous and the floors may be intercostal between the girders.

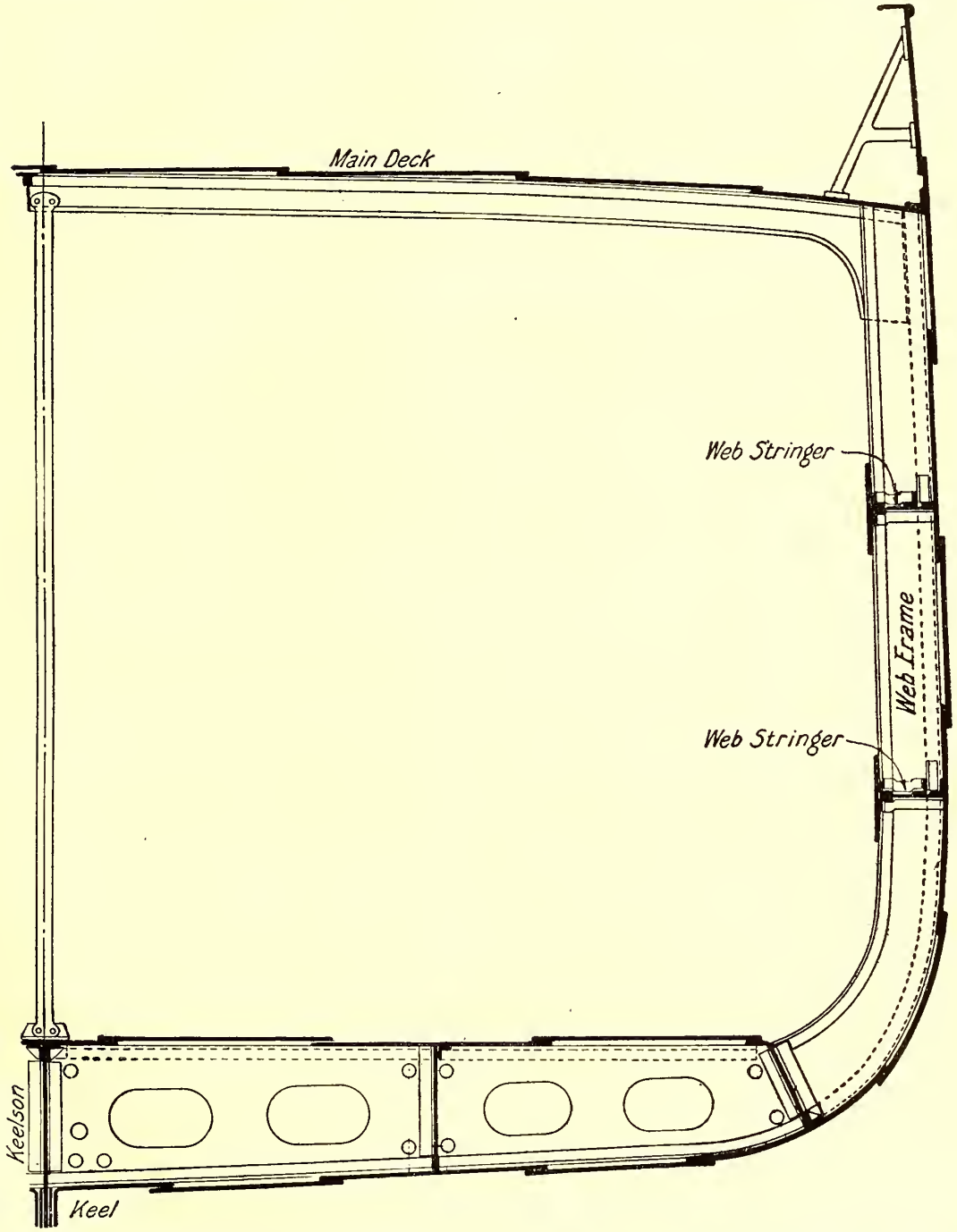
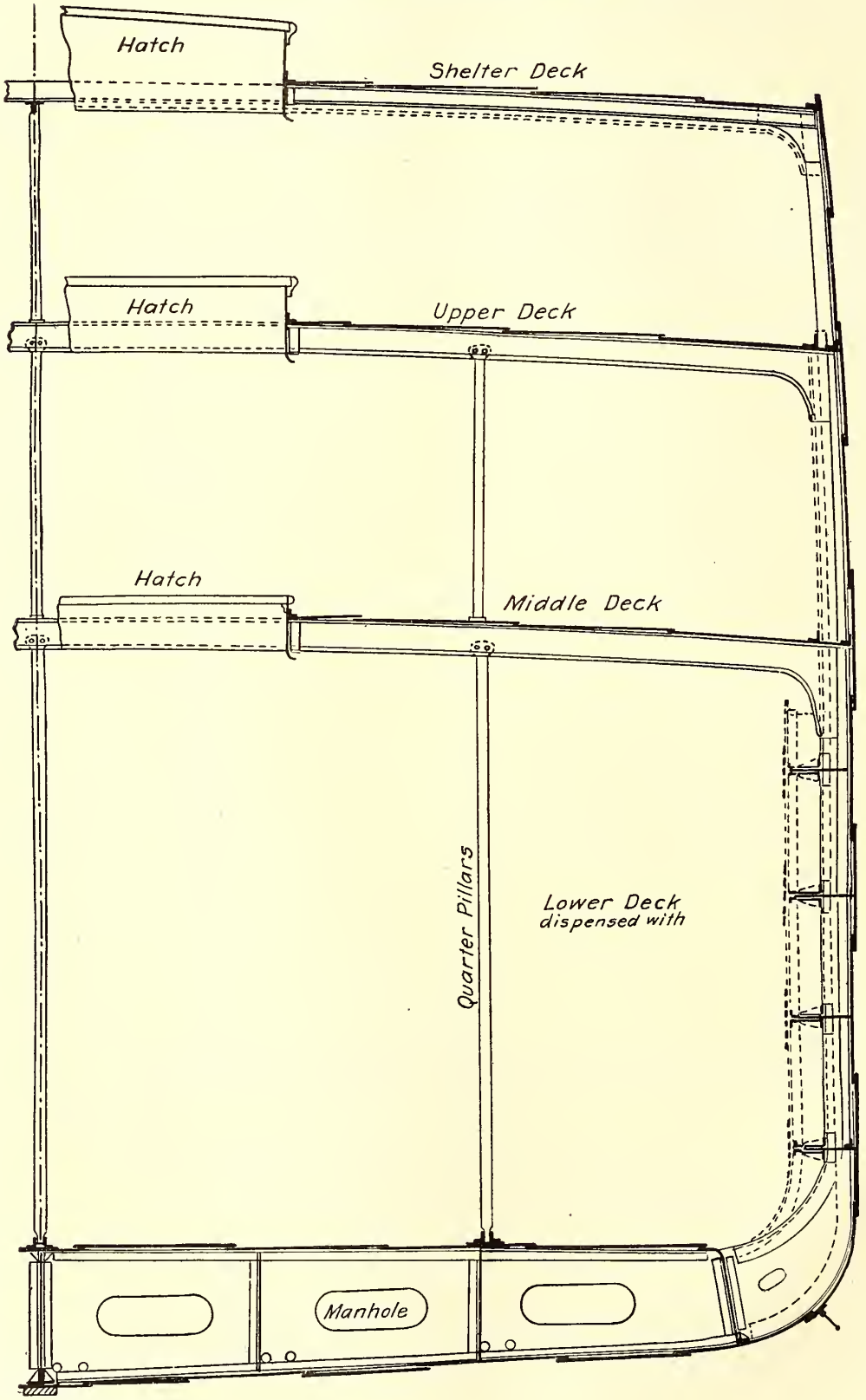


FIGURE 2.—Midship section of two-deck vessel. The second deck dispensed with, the vessel being given compensating strength by web frames and side stringers.

Figure 3 is the drawing of a half cross-section of a three-deck vessel. The lower deck is omitted, and compensating strength is given the hull by introducing web frames for each fifth frame and by stiffening the hull by means of heavy longitudinal side stringers placed

FIG. 4. MIDSHIP SECTION OF A STEAMER WITH THREE DECKS AND A SHELTER DECK, LOWER DECK DISPENSED WITH.



intercostally between the web frames. The web frames extend only to the main deck; and it will be noted that there is a main-deck beam for each frame and that the main-deck floor is of steel plates. The upper deck construction is lighter; there are beams only for each alternate frame and the deck flooring is of wood. Instead of using web frames to strengthen the hull of vessels from which the lower deck is omitted, it is now more usual to employ "deep framing," i. e., to use deeper frames all of the same size.

Figure 4 is a midship half section of a vessel with three decks besides a shelter deck. The lower deck is dispensed with to permit cargo to be stored in the hold and handled in and out more advantageously. The strength of hull sacrificed by leaving out the lower deck beams and floor is compensated for by web framing and by side stringers. The significance of the term "shelter deck" is explained below in discussing three and four decked vessels.

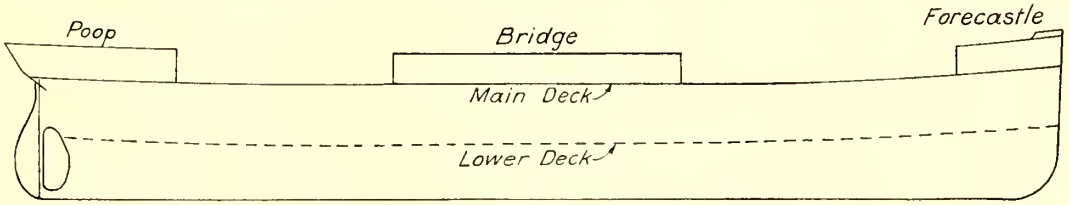


FIGURE 5.—Profile of a two-deck ship with forecastle, bridge, and poop.

The early ocean steamers and some of the small freight vessels now in service were constructed with two full decks, the lower and main decks, above which were placed the three usual superstructures—the forecastle, bridge, and poop. The outline sketch, figure 5, indicates the general design of the two-deck vessel.

In a two-deck ship the main deck may, as in figure 5, extend without a break from stem to stern; but the more usual practice is to raise the deck 4 or 5 feet from abaft the bridge to the stern, as is shown in figure 6, the raised portion of the main deck being called the quarter-deck. In a two-deck general cargo steamer it is usual to place the engine amidships, and the main purpose of the quarter-deck is to increase the capacity of the after cargo hold, which, on account of the space occupied by the shaft tunnel connecting the engine room with the propeller, and on account of the finer lines of the aft part of the hull as compared with the fore body of the ship, has less volume than the forward cargo hold. A vessel with a forward hold

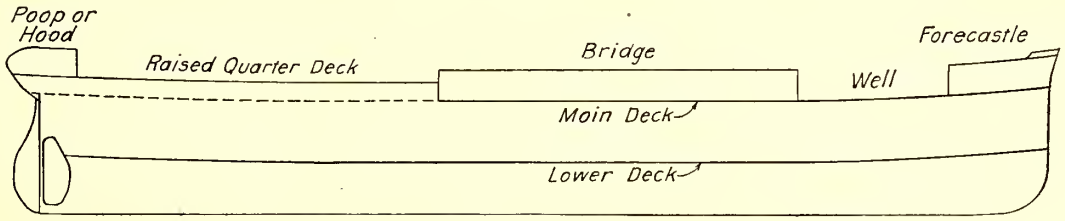


FIGURE 6.—Profile of a raised quarter-deck, well-deck steamer.

larger than the aft hold would tend to trim to the bow when loaded with homogeneous cargo. The quarter-deck enables the vessel to be loaded to an even keel.

The forecastle and bridge being inclosed against the sea add to the buoyancy of the vessel, and with the early development of the ocean freight steamers the bridge was extended and brought nearer to the forecastle. In heavy weather the deck between the forecastle and bridge being awash, the space was appropriately called the well and the steamer with a well was called a well-deck ship. To increase the freeboard and reduce the shipping of water, the main deck forward of the bridge is sometimes raised 4 or 5 feet to form a raised fore deck. Such vessels are called "raised fore deckers." These types of ships are still used to some extent in the charter freight service. Figure 6 indicates the general arrangement of a raised quarter-deck, well-deck steamer. If the vessel were a raised fore decker the well would be shallower.

The more detailed profile (fig. 7) of a well-deck steamer, without a quarter-deck, shows the location of the main parts of the ship. The lower deck is dispensed with and the hull is given compensating strength by deep framing and, in the engine and boiler rooms, by substituting "web frames" or beams for some of the frames. The vessel has a double bottom containing water ballast tanks. As is customary, the narrow parts of the ship at the bow and stern contain peak tanks that are generally used to carry water ballast. The bridge, as is usual, is built around the casings inclosing the smoke funnel and the ventilating spaces above the engine and boilers. The poop and forecastle are closed in and used for crew quarters and freight stowage. The profile also shows such other parts of steamers as the anchor-chain locker, bulkheads, hatches, deck house, and shaft tunnel, engine funnel, donkey engine and boiler recess, water-ballast tanks, steering-gear house and deck houses, all of which are spaces considered in measurement, and must be provided for in any code of measurement rules. They are indicated in figure 7 in case of a simple two-deck "well"-deck steamer, in order that the repeated use of these terms in succeeding chapters dealing with measurement rules may not be confusing.

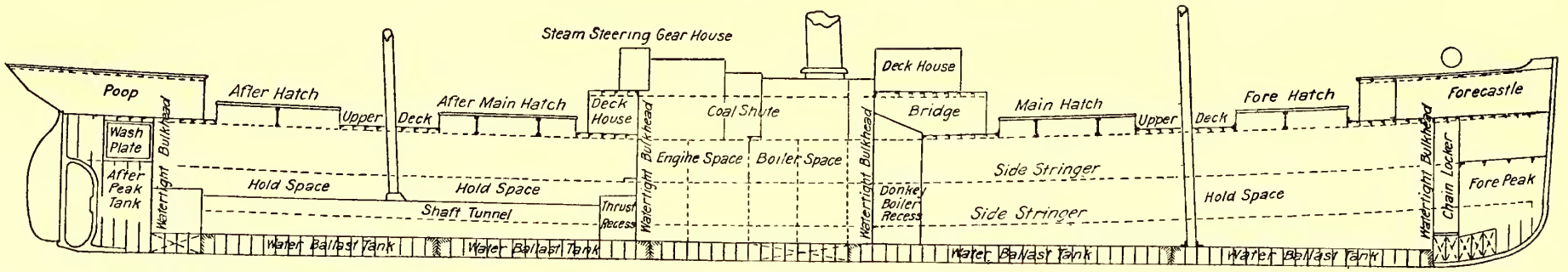
The typical ocean steamer of to-day is a three or four decked vessel, i. e., a vessel with three or four full-length decks. Until recently the three-deck vessel was the standard, and it might be a full scantling or "three-deck" vessel, a spar deck, an awning deck, or a shelter-deck vessel. In a "three-deck" vessel the frames are carried full sized to the upper deck, which is the strength deck of the ship. When the frames are made somewhat lighter between the middle and upper deck and the upper deck is of lighter construction, the vessel is a spar-deck ship; and if the construction above the middle deck is still lighter, and the middle deck is the strength deck, the vessel is called an awning-deck ship. The space between the awning and middle decks is closed against the sea and used to carry light cargo, cattle, or passengers. If there are one or more permanent openings left in the upper deck, so that in heavy weather the sea may invade the space between the upper and middle decks, the upper deck is called a shelter deck—not an awning deck—and the ship is named a shelter-deck vessel.

The "three-deck" ship being stronger than a spar-deck vessel, is allowed the smallest freeboard, while the spar-deck ship is allowed less freeboard than is permitted an awning-deck vessel. For carrying heavy cargoes in rough seas the "three-deck" ship is preferable, while for transporting light commodities and package freight and passengers the awning-deck ship is preferable. The desirable strength and weight of a vessel are determined by the service it has to perform.

The use of the term "shelter deck" in shipping literature and in measurement rules is confusing. Originally the shelter deck was one erected above the main deck or the upper deck to shelter cattle or other cargo that did not need to be carried in spaces from which the sea was completely excluded at all times. The shelter deck had permanent openings, while the awning deck was capable of being completely or "permanently closed in." With the evolution of ships, however, the shelter-deck vessel has come to differ very little from the awning-deck ship, as is clearly shown by figure 8, which is a profile of a steamer having lower, main, and shelter decks.

The profile of the steamer illustrated by figure 8 shows that the shelter deck has closable hatches above all the hatches in the main and lower decks, but that there is a small tonnage opening in the shelter deck abaft the after hatch, placed there to meet the requirement of the British Board of Trade measurement rules. In order that this ship may be classified as a shelter-deck vessel by the Board of Trade, the tonnage opening must be not less than 4 feet long fore and aft and be at least as wide as the width of the after-cargo hatch on the same deck. The after edge of the tonnage opening must be distant from the aft side of the sternpost by not less than one-twentieth the registered length of the vessel. If the tonnage opening is placed forward, the fore side of it must be not less than one-fifth of the length of the vessel from the stem. Through the bulkheads that subdivide the space between the shelter and main decks there must be "permanent openings" at least 3 feet wide and 4 feet high; and, if coamings are fitted thereto, their height must not exceed 2 feet. When the permanent

FIG. 7. PROFILE OF A TWO-DECK "WELL"-DECK STEAMER.



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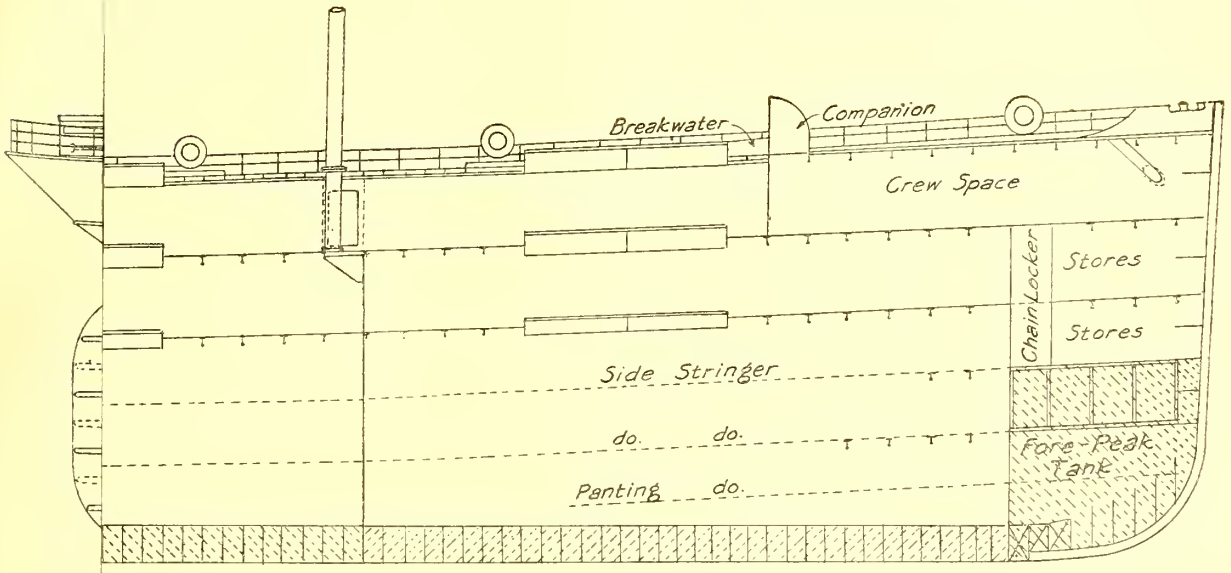
Breakwater
Companion
Crew Space
Chain Locker
Stores
Stores
Side Stringer
do. do.
Panting do.
Fore Peak Tank

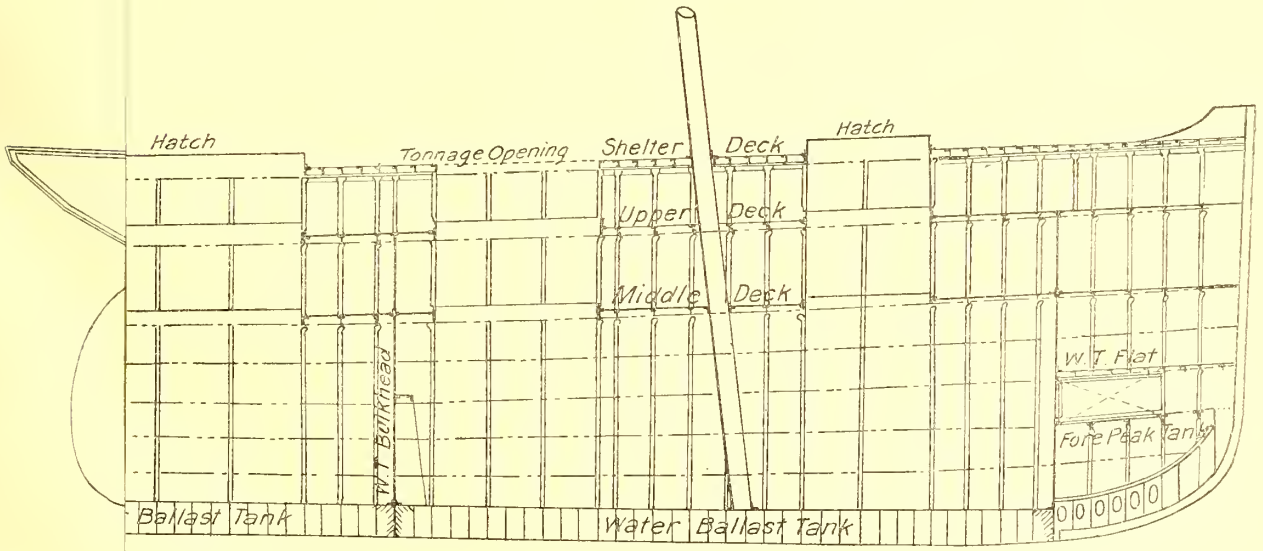
Hatch
Tonnage Opening
Shelter Deck
Hatch
Upper Deck
Middle Deck
W.T. Bulkhead
W.T. Flat
Fore Peak Tank
Ballast Tank
Water Ballast Tank

FIG. 8. PROFILE OF A STEAMER HAVING LOWER, MAIN, AND "SHELTER" DECKS.

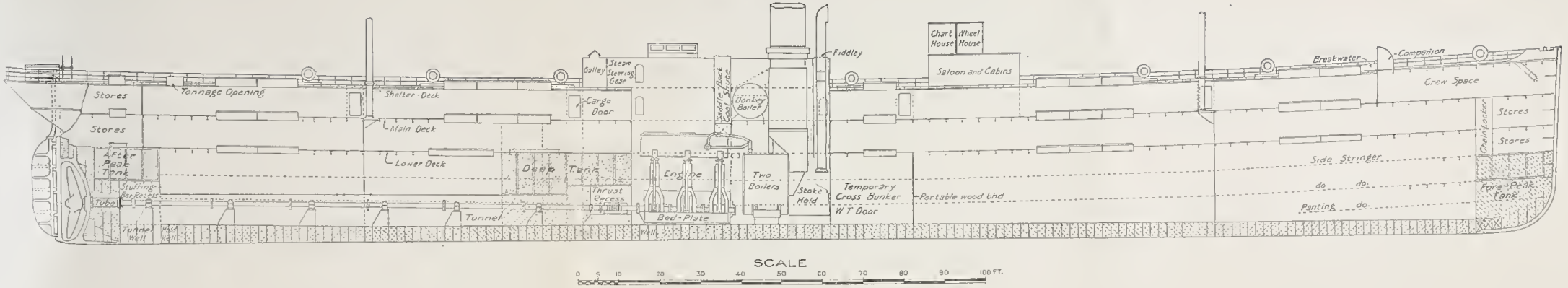

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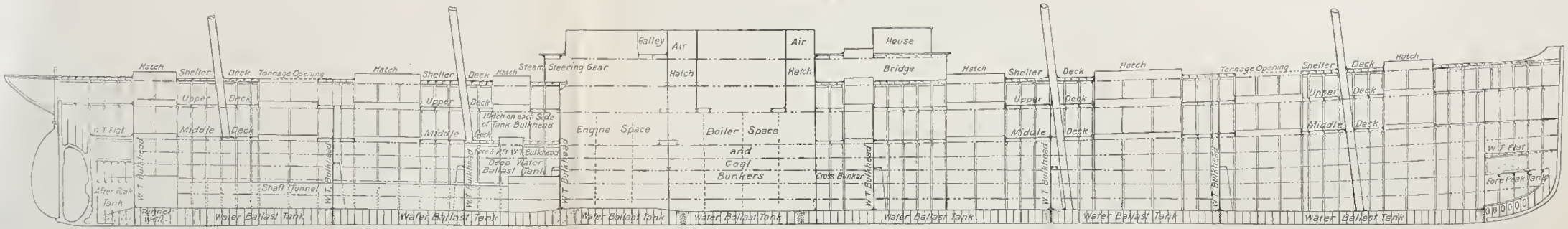
FIG. 9. PROFILE OF A STEAMER WITH THREE DECKS AND A "SHELTER" DECK.



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deck opening is situated aft, there must be at least two openings in all the transverse bulkheads in the 'tween deck on the fore side of it to entitle the space to exemption.

As will be explained later, the regulations governing vessel measurement in some countries other than Great Britain, particularly in the United States, define closed-in and open spaces more rigidly; and the 'tween deck space under the "shelter deck" is usually included in the shelter-deck vessel's tonnage by American admeasurers. The British Board of Trade and its admeasurers are compelled by an unfortunate decision of the House of Lords rendered in 1875 to treat as "open" the spaces under the shelter deck (and also under the bridge deck) that fulfill certain stipulations which prevent spaces from being considered as technically closed-in spaces, which American admeasurers treat as capable of being closed-in and as available for the stowage of dry cargo.

As actually constructed at present, there is but little difference between three-decked vessels classified as awning-deck and shelter-deck ships. In the awning-deck vessel, the 'tween deck spaces under the awning deck have only hatch openings which can be made weather proof; while vessels, constructed to meet the requirements of the British Board of Trade regulations as to shelter-deck openings, must have a tonnage hatch that can not be tightly battened down; it must have the bulkhead openings above described, and there must be scuppers and water ports to carry off the water that may reach the main deck. The ports, however, may have back valves to prevent the sea from washing in, and the tonnage hatch may be so constructed as to enable it to be so covered as temporarily to keep the sea water from invading the 'tween-deck space. In practice, British vessels which fulfill the Board of Trade requirements as to shelter-deck openings frequently carry dry cargo in the spaces under the shelter deck. When cargo is so carried, the British admeasurers add the space actually occupied by the cargo to the tonnage, upon which light dues and port charges are payable, but the 'tween-deck spaces are not added to the vessel's gross or net tonnage. In the United States and at the Suez Canal, on the contrary, the entire 'tween-deck space is included in the tonnage, if any dry cargo is or may be carried in the space.

The shelter deck is not necessarily the third or "upper" deck. It may be the fourth deck, as in the ship illustrated by the profile in figure 9. That vessel has an upper and a middle (or main) deck, the lower deck being dispensed with and compensated for by additional strength of framing. A ship built according to the profile shown in figure 9 exceeds the minimum requirements of the British rules as to open spaces, two tonnage openings being provided—one fore and one aft. If either one of these openings were kept permanently open and if the bulkheads between decks under the top deck were provided with permanent openings, there would be no question that all the space between the shelter and upper decks would be excluded from net tonnage by the British measurement rules; but, as a matter of fact, there is no reason other than that of keeping the vessel's net tonnage at a low figure why the bulkheads between decks should have nonclosable openings. In a vessel with four decks, nearly all of the space under the "shelter deck" would naturally be used for accommodating passengers or for stowing miscellaneous cargo.

The term "shelter deck" is sometimes applied to the fourth deck on large steamers (figs. 11, 12, 13, 14, 21, and 22), even though such deck has no tonnage openings whatever, but is a complete deck in every sense and is so regarded under the measurement rules of all nations. This terminology adds to the confusion concerning shelter decks, for such decks are so named merely for convenience. They are not shelter decks in the meaning of measurement rules and as the term is ordinarily used. A modern shelter-deck ship is one which has a full-length deck fitted with one or more tonnage openings, with scuppers and ports, and with bulkhead openings as provided in the measurement rules of Great Britain. The measurement or exemption of such shelter-deck spaces when fitted with tonnage openings, which are but technical openings, has been and is one of the main differences between the measurement rules of the several nations.

Passenger vessels are sometimes fitted with a so-called "shade deck" or lightly constructed covering over the uppermost deck to afford a shelter and to provide a promenade for passengers. Ordinarily such a deck is constructed with light deck beams supported on round iron stanchions,

frame angles, or tee bars. The sides of the spaces under such a light deck may be entirely open fore and aft, or they may be partly closed-in as shown in figure 10. When partly closed-in the sides are fitted with side openings, the shade deck, therefore, affording no additional buoyancy to the ship. Its light construction renders it practically valueless as a contributor to the vessel's structural strength, and since the space below the shade deck is exposed to the sea and weather, it is nowhere regarded as a part of a vessel's gross or net capacity for carrying dry cargo or passengers. The tonnage rules of the United States, Great Britain, Germany, and the Suez Canal Co. expressly exempt such spaces from tonnage measurement, excepting, of course, any closed-in structures which may be located under the shade deck.

On a large passenger steamer the shade deck is sometimes called the promenade deck. Originally they were variously known as awning and shelter decks. Modern awning and shelter decks, however, though outgrowths of the shade deck, must be clearly distinguished, for modern awning-deck spaces are always closed-in and are distinctly parts of a vessel's closed-in capacity. Modern shelter-deck spaces, though fitted with a technical tonnage opening, are also, as a rule, available for the stowage of dry cargo. Both awning and shelter decks, moreover, add to a vessel's structural strength, and as neither has side openings they add to the ship's buoyancy.

The larger class of ocean freight vessels in service at the present time have four full-length decks, and if constructed for the combined freight and passenger services there are two or three tiers of superstructures above the fourth deck. A midship section of a vessel designed with particular reference to the traffic between American ports through the Panama Canal (fig. 11) illustrates the arrangement of a typical combination freight and passenger steamer. The vessel's length is 500 feet, its beam 64 feet 6 inches, and its depth, to the shelter deck, 42 feet.

The vessel whose midship section is shown in figure 11 has four full decks—the lower, main, upper, and shelter decks. The term "shelter deck" is applied to the fourth deck, as is customary,

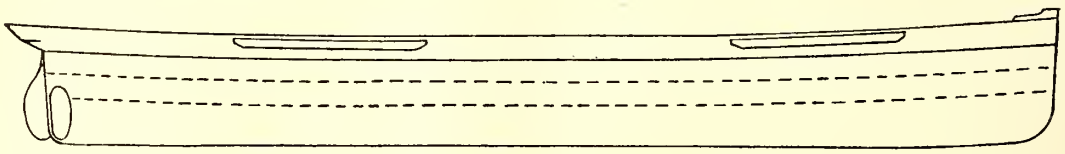
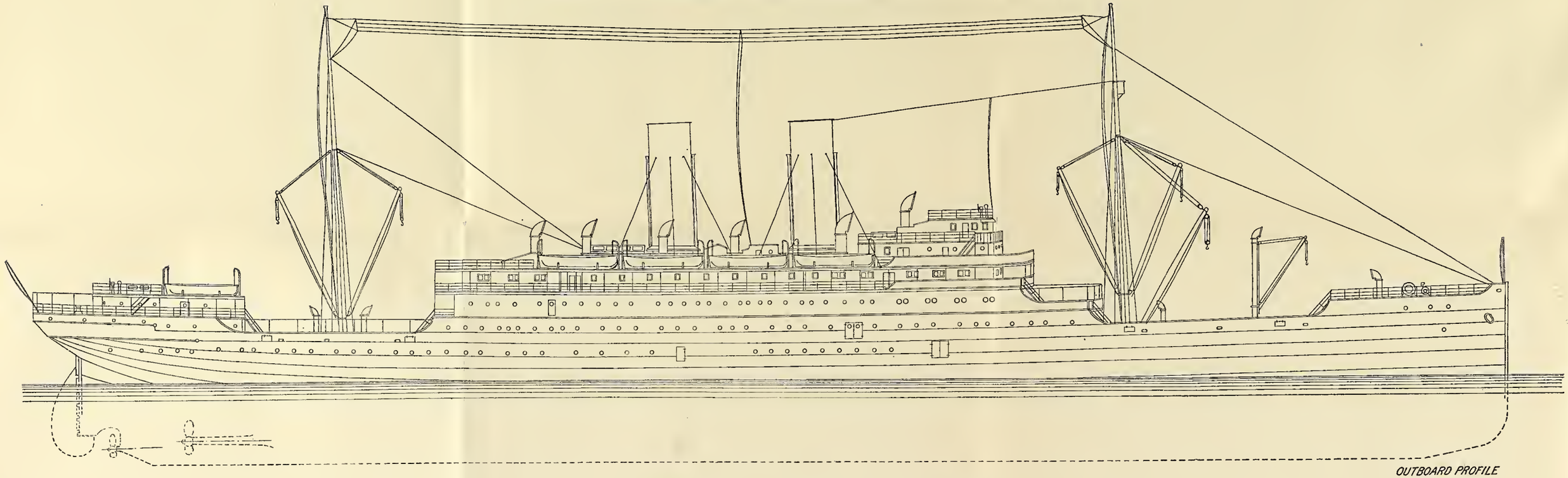


FIGURE 10.—Profile of vessel with shade deck.

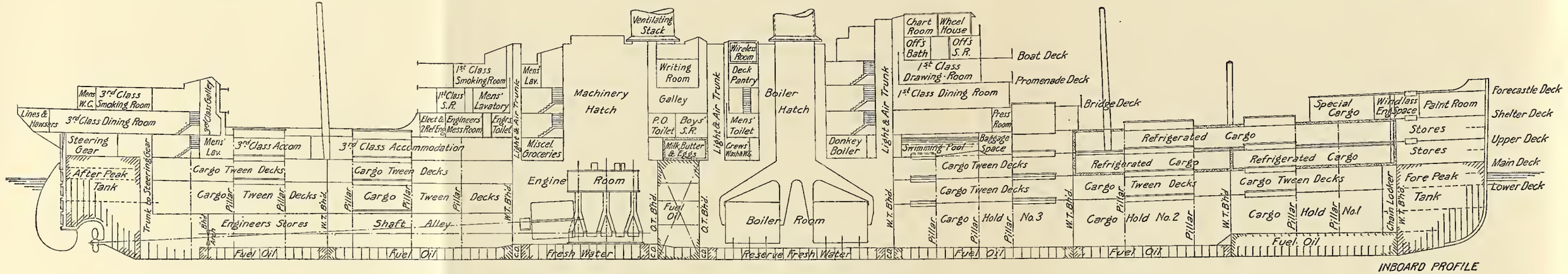
although the vessel is not of the shelter-deck type. Even in Great Britain, where shelter decks are exempted, the fourth deck space of this vessel would be measured. The space between the shelter and upper deck, as is shown in figure 12, is devoted to passenger accommodations and the stowage of stores and refrigerated cargo. It may be noted in passing, that this vessel, being intended to carry miscellaneous cargo and package freight, has lower deck beams and plating. (Fig. 11.) There is no necessity for keeping the hold without subdivision other than bulkheads below the main deck. For all decks below the boat deck there is a beam on every frame. The pillars are spaced 15 feet apart. The frames are spaced 24 inches apart at the peaks, 30 inches "between the forward peak and one-third forward," and 36 inches elsewhere. Below the main deck there are three web frames on each side of the engine room and two on each side of the boiler room. To strengthen the vessel amidships, web frames are introduced into the framing from the main deck up to the promenade deck. Outboard and inboard profiles of this vessel and a plan of its lower deck are shown in figure 12.

The outboard profile of the vessel illustrated by figure 12 shows the superstructures usual for a combination freight and passenger steamer. There is a forecastle which is used for stowage purposes. The poop and the after part of the 'tween decks under the shelter deck are devoted to third-class passenger accommodations. There are no second-class rooms. The first-class passenger accommodations are amidships between the upper and shelter decks and above the shelter deck in the amidship superstructures, of which there are three tiers covered by the bridge, promenade, and boat decks. The wheelhouse and chart room are on a short deck one tier above the boat deck. The light and air hatches and the stack casing are inclosed by the surrounding superstructures. It is seen at a glance that the number of superstructures on this

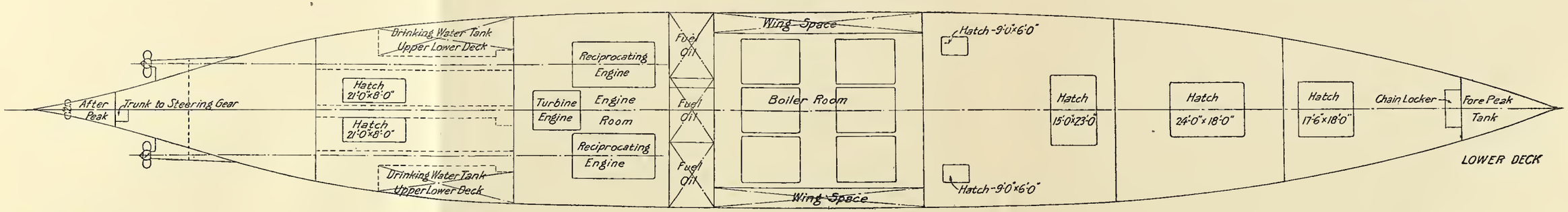
FIG. 12. PROFILES OF TRIPLE-SCREW STEAMSHIP, DESIGNED FOR THE PANAMA CANAL SERVICE.



OUTBOARD PROFILE



INBOARD PROFILE



LOWER DECK

FIG. 11. MIDSHIP SECTION, FREIGHT AND PASSENGER VESSEL, PANAMA CANAL SERVICE.

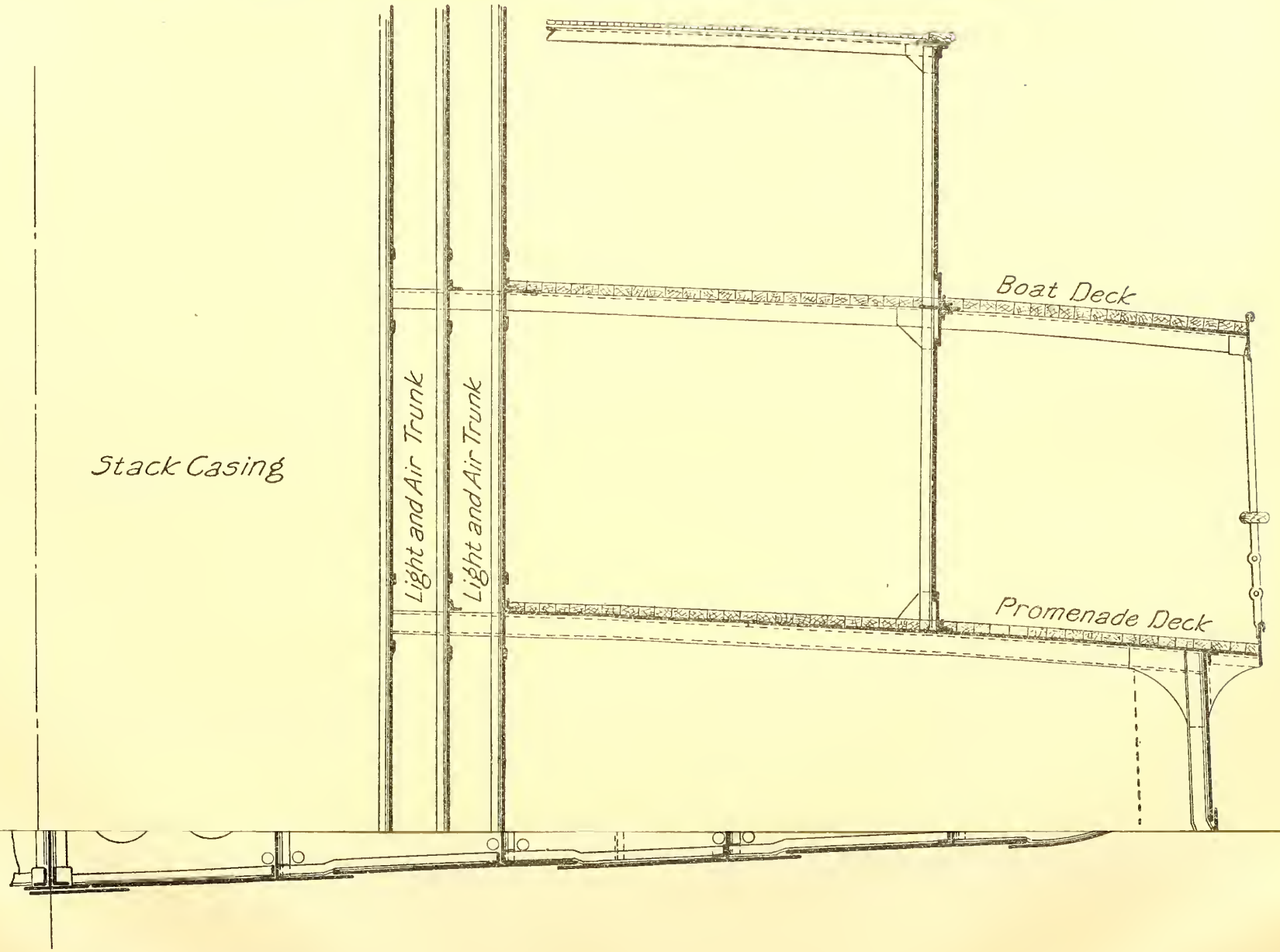
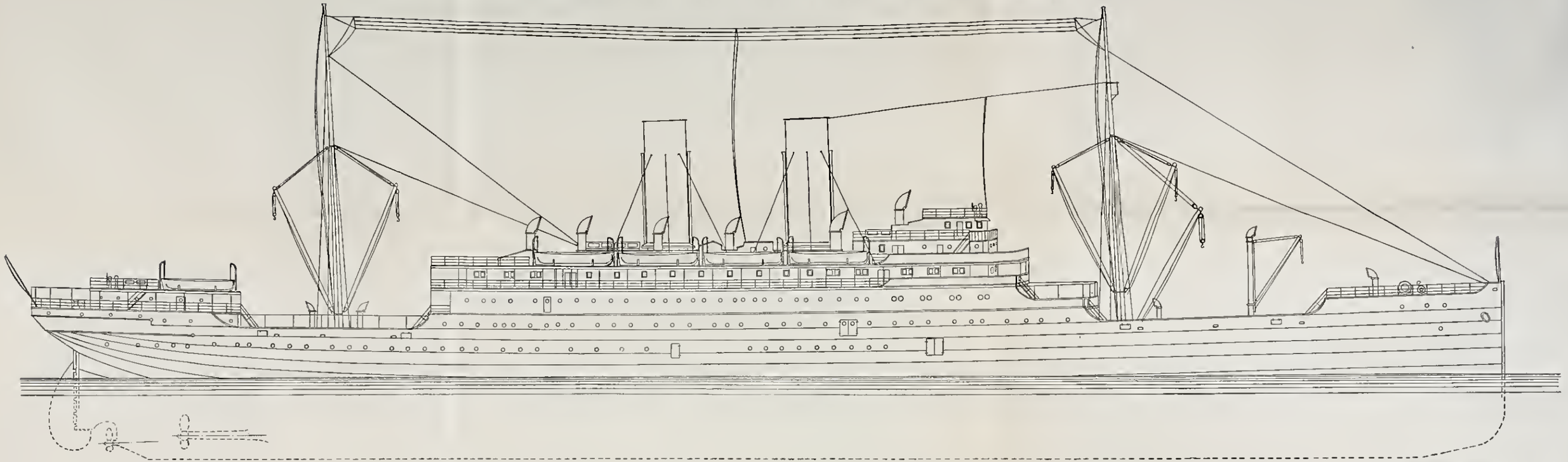


FIG. 12. PROFILES OF TRIPLE-SCREW STEAMSHIP, DESIGNED FOR THE PANAMA CANAL SERVICE.



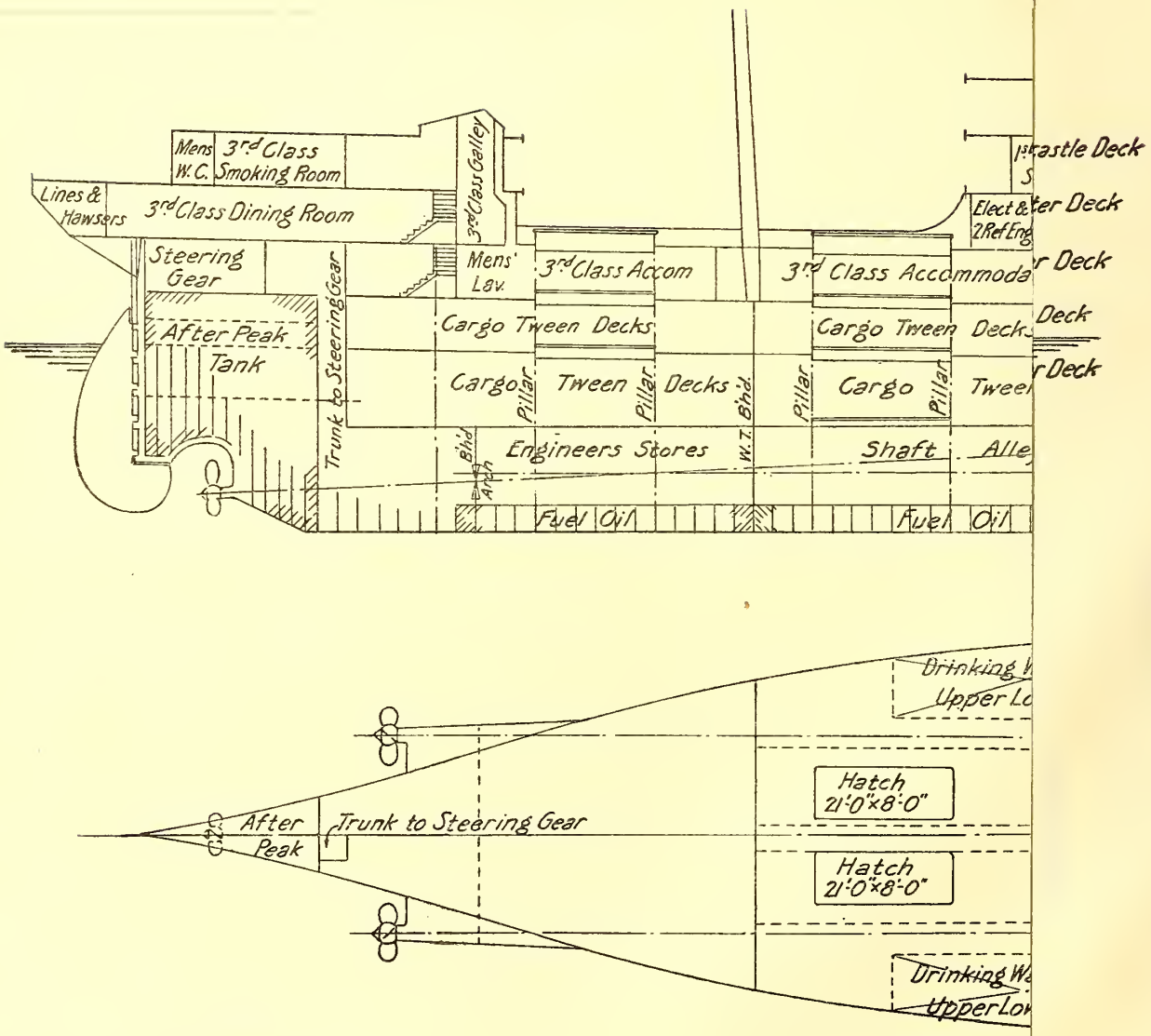
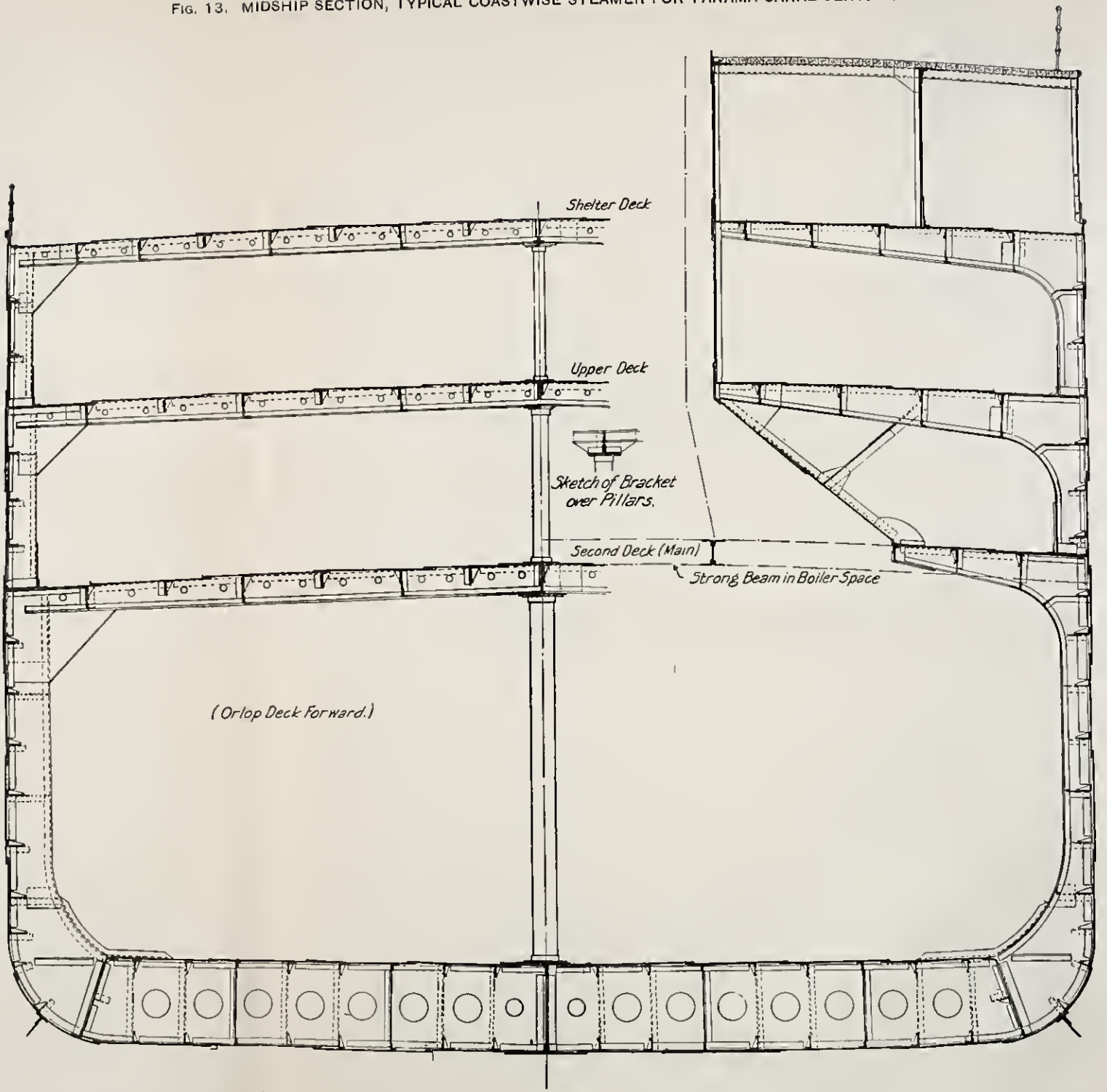

Mens W.C.
3rd Class Smoking Room
Lines & Hawsers
3rd Class Dining Room
3rd Class Galley
Steering Gear
Mens' Lav.
3rd Class Accom
3rd Class Accommoda
After Peak Tank
Trunk to Steering Gear
Cargo Tween Decks
Cargo Tween Deck
Cargo
Pillar
Tween Decks
Pillar
B'hd.
Pillar
Cargo
Pillar
Tween
W.T. B'hd.
Engineers Stores
Shaft
Alley
Arch
Fuel Oil
Fuel Oil
Hatch 21'-0"x8'-0"
Hatch 21'-0"x8'-0"
After Peak
Trunk to Steering Gear

FIG. 13. MIDSHIP SECTION, TYPICAL COASTWISE STEAMER FOR PANAMA CANAL SERVICE.



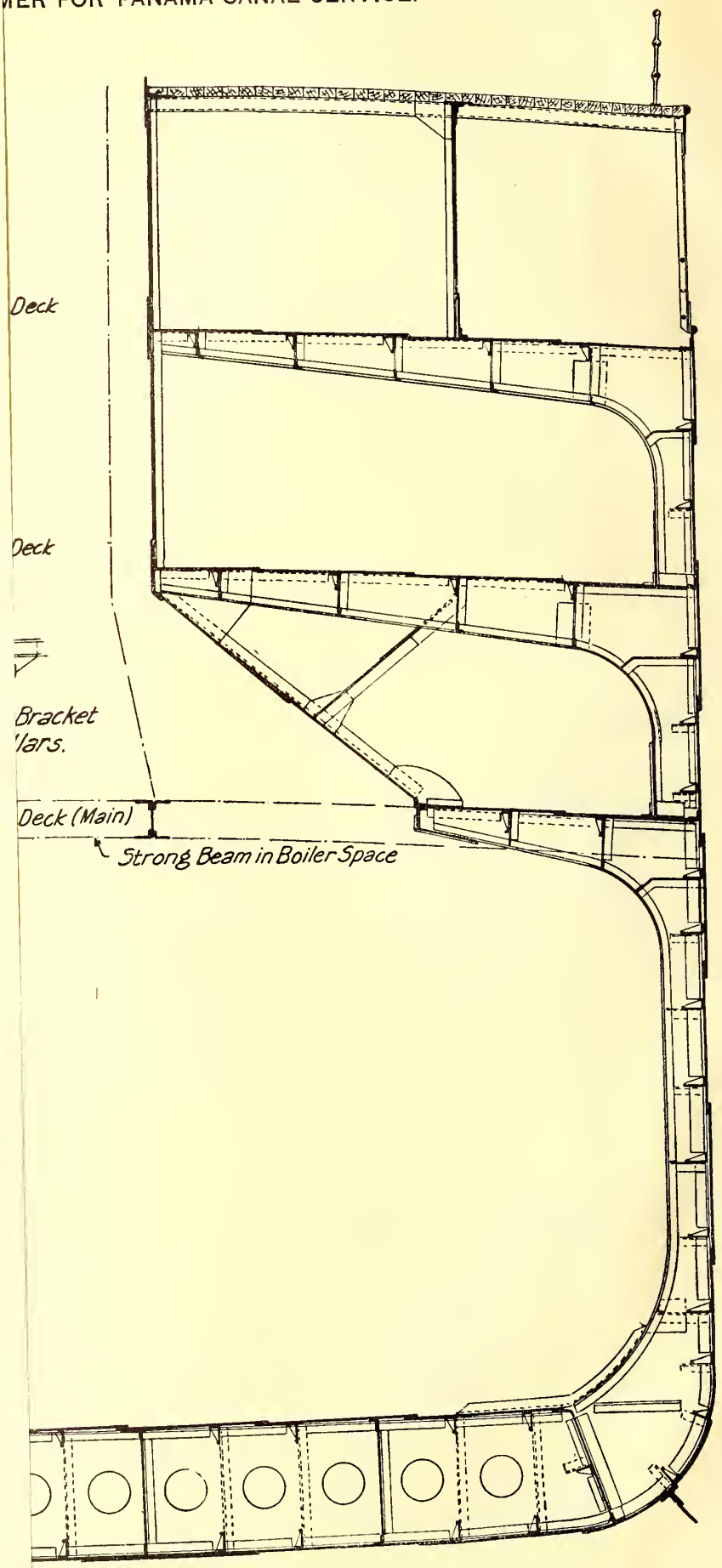
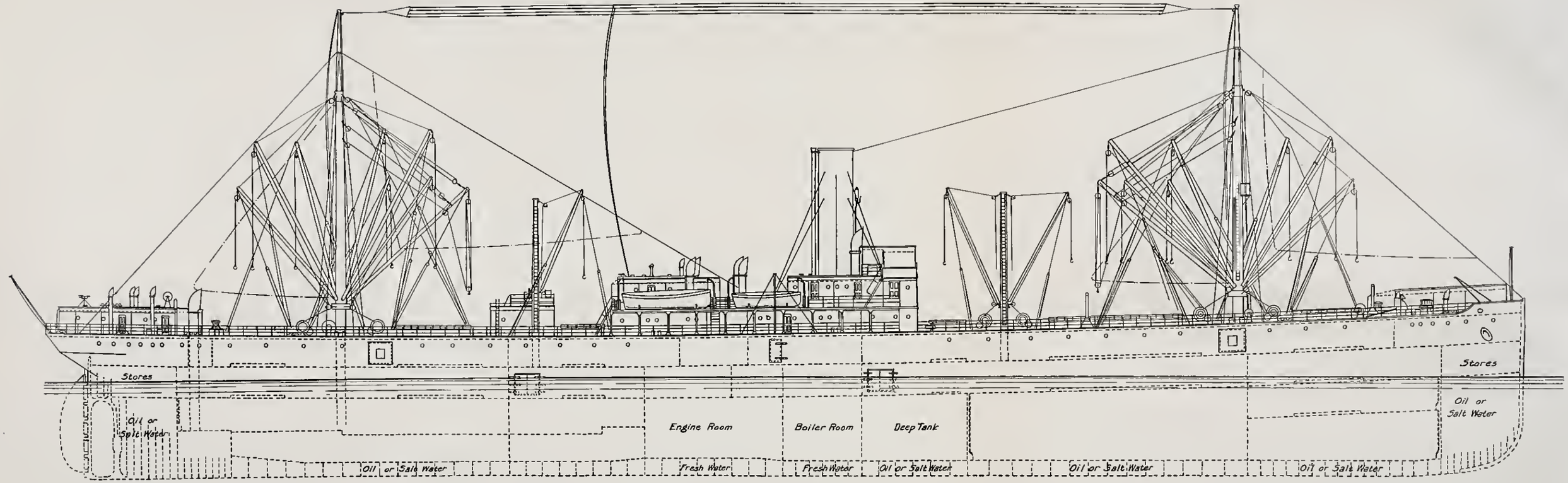
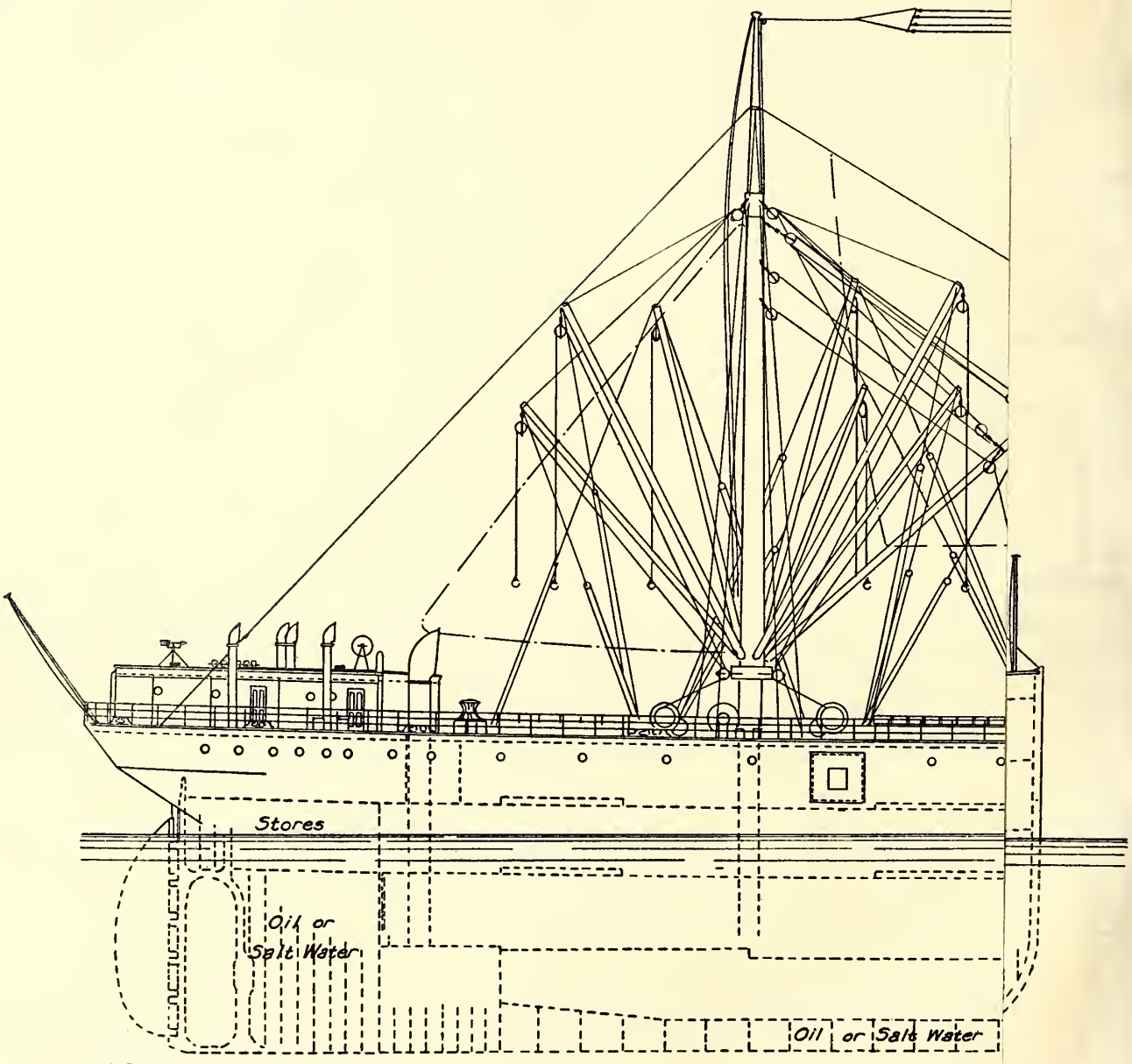

Deck
Deck
Bracket
lars.
Deck (Main)
Strong Beam in Boiler Space

FIG. 14. PROFILE OF TYPICAL COASTWISE STEAMER FOR PANAMA CANAL SERVICE.





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vessel is mueh greater than in case of the ordinary two-deek well-deek steamer of figure 7. Every sueh inerease in superstruetures adds to the importancc of the rules providing for their measurement or exemption. Measurement practiees in this regard are widely different in the several nations, and, as is diseussed in Chapter XI, superstructures have for many years given rise to serious measurement diffieulties.

The inboard profile in figurc 12 shows the use to be made of eaeh of the subdivisions of the above-deek and under-deek spaees. The plan of the lower deck shows the loeation of the several hatches. Thc vessel is to usc fuel oil carried partly in the double bottom and partly in a large 'thwartships tank between thc engine and boiler rooms. There are three propellers, the side propellers being driven by rcciproeating engines, thc eenter serew having a turbine engine.

A type of the vessel illustrated by figures 11 and 12 has a speed of 15 or 16 knots, and has too high construction and operation costs for the transportation of heavy or low-grade freight. It is intended for the transportation of high-grade, miseellaneous, and express freight at sueh speed—14 or 15 knots—as must be maintained by a vessel in thc passenger service through the canal. In order to bc profitable, a vessel of that type and speed must derive a relatively large sharc of its ineome from thc third-class and first-class passenger fares. Experienee will be required to determine whether a vessel of this type will prove profitable in the American eoastwise service through the eanal or in a serviec between the eastern seaboard of the United States and forcign Pacific countries.

Figure 13 gives midship seetion and figure 14 a profile of one of the eight vessels eonstituting the 1912 and 1913 additions to thc flect of the Ameriean-Hawaiian Steamship Co. The vessels of this type are designed solely for the transportation of freight. They can average 14 knots at sea, but are operated at 12 knots, and some of them are now profitably employed, together with the other vessels of the eompany's large flect, in thc services between New York and the Isthmus of Tehuantepee and between that isthmus and the ports of the Pacifie eoast of the United States and the Hawaiian Islands. Miscellaneous eargo is earried in both directions, and bulk eargo, especially Hawaiian sugar, is handled eastbound. The vessels are about 415 feet long between perpendieulars and are of 53 feet 6 inehes beam. Their molded depth to the shelter deek is 39 feet 6 inehes. Thcir gross tonnage, Ameriean measurement, is about 6,600 tons and their net tonnage about 4,200 tons. Each vessel will earry about 10.000 tons of eargo.

The main structural features of these vessels are shown in figure 13. The ship is a four-deek vessel, with a eellular double bottom and a seeond, an "upper" and an uppermost deck which the builders term a shelter deck, but which is completely closed-in. The lower deek is dispensed with and compensating strength is given the hull in the framing up to the second (main) deck; but an orlop [1] deck takes the place of the lower deck in the forward part of thc hold from the fore peak tank aft for about one-eighth the length of the ship. The vessel being of moderate beam and of strong side framing, there is but one row of hold pillars which rest upon the keelson at the center line of the ship.

The left half of figure 13 is a midship section forward and aft of the engine room and boat deck; while the right half of the drawing gives the section through the engine room. The crown of the engine room is at the upper deck, above which the air hatch extends through the shelter and boat decks. In this vessel, as in that illustrated by figures 11 and 12, the shelter deck does not have a tonnage hatch or opening. The space below the shelter deck is permanently inclosed and ean be used to stow dry cargo. They are not vessels of the "shelter deck" type.

Figure 14 gives the profile of the vessel of which the midship section is shown in figure 13. The vessel is without forecastle. Above the shelter deck, however, there are two part-length decks—the boat and bridge decks. Crew accommodations are provided in a short poop and in

[1] Orlop, according to the International Dictionary, is a contraction of over and leap or of over and loop, the orlop deck being defined as "the lowest deck of a vessel, especially of a ship of war, consisting of a platform laid over the beams in the hold, on which the cables are coiled." Apparently the term originated with warships, but it is now often applied to the lowest deck of a merchant ship having four or more decks. Passenger ships of exceptional depth may divide the hold below the lower deck by two orlop decks. The *Lusitania*, of the White Star Line, has the following decks, named in order from the lowest to the highest: Lower orlop, orlop, lower deck, main, upper, shelter, promenade, and boat decks—eight in all.

the 'tween decks under the boat deck. The officers' quarters are on the boat deck, and there is a bridge under a short open-bridge deck above the boat deck. Since this vessel is designed solely for the freight service the number of above-deck erections is far smaller than in the case of the combination freight and passenger steamer illustrated in figures 11 and 12 above, and the tonnage considerations are consequently less complex. The profile shows the location of the orlop deck and of those above, of the engine and boiler rooms, and of the deep tank. The vessel is a twin-screw steamer with oil-burning, reciprocating engines. Fuel oil is ordinarily carried in the large, deep tank placed athwart ships forward of the boilers. The double-bottom and peak tanks are ordinarily used for water ballast except when long-distance steaming requires their use for fuel oil.

The type of ship that will doubtless be largely used for the freight service between the eastern seaboard of the United States and the west coast of South America is illustrated by figures 15 and 16. The vessel illustrated by these two figures has a length of 384 feet on the upper deck, a molded breadth of 50 feet and a molded depth to the upper deck of 28 feet 6 inches. The depth to the bridge deck is 36 feet 6 inches. The midship section shows the vessel to have but three full-length decks. There is an upper and a second deck, but the lower deck is dispensed with, except that the orlop deck subdivides the forward cargo hold. It, however, has two partial decks above the upper deck—a bridge deck and an upper bridge deck. The vessel has a double bottom for fuel and water ballast. The framing is made heavy, in order to compensate for the absence of the lower deck and to reduce the number of hold pillars. The wheel and chart houses and the captain's cabin, moreover, are on a very short deck above the upper-bridge deck. The various above-deck erections are similar to those of the vessel illustrated in figures 13 and 14 above, as both vessels are designed for freight service through the Panama Canal.

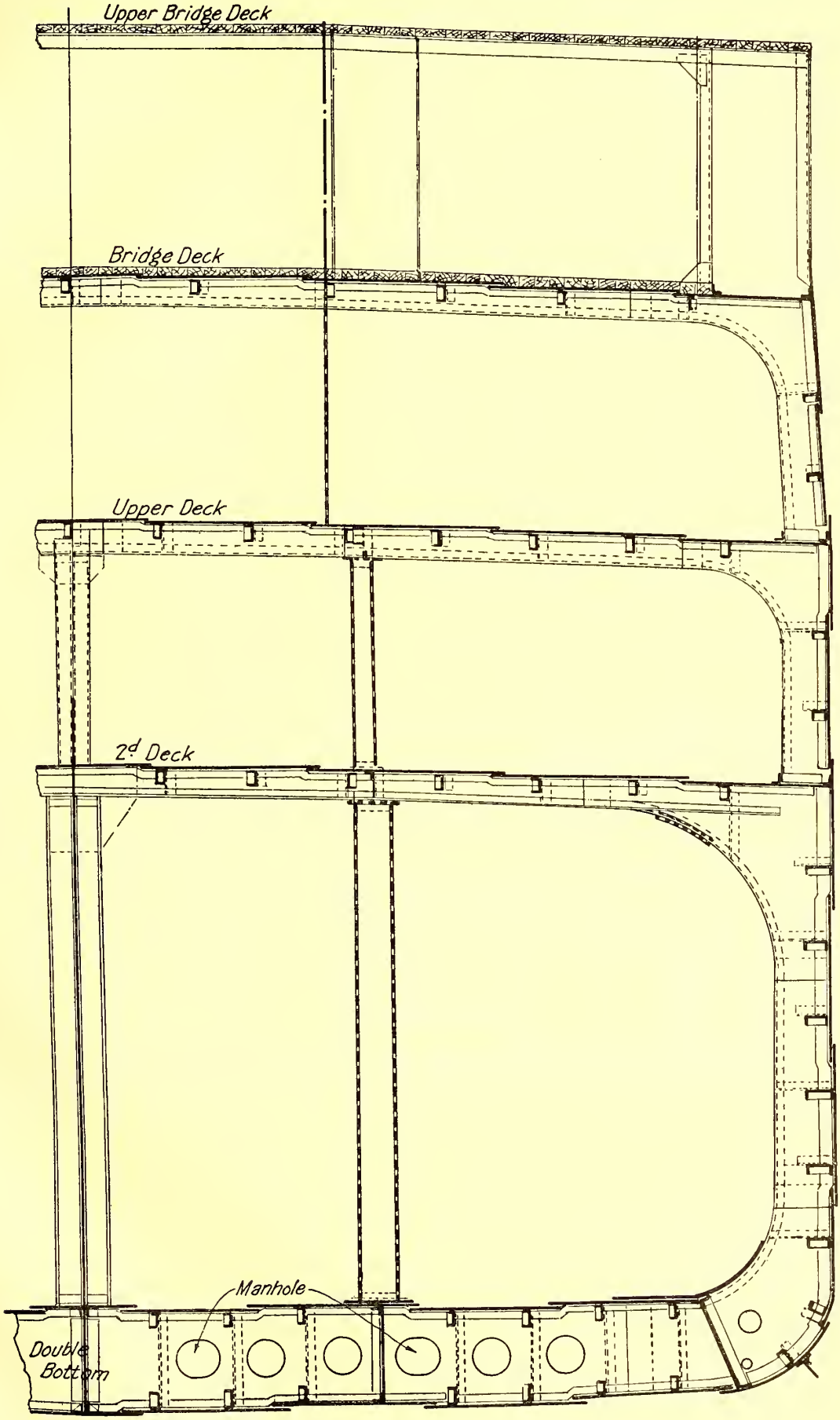
The longitudinal profile of the steamer illustrated in figure 16 shows that oil is carried both in the double bottom and in a deep tank, the deep tank being placed forward of the fireroom. The vessel being an oil-burning steamer has a comparatively small boiler room, differing in this respect from many other oil-burning steamers, which are designed to burn both coal and oil, and which therefore have boiler rooms as large as those on coal-burning steamers of the same power.

The three vessels illustrated by figures 11 to 16 represent standard types of vessels that will probably be largely used in the coastwise and foreign commerce of the United States through the canal. They were designed in 1911 and 1912 for the canal service. Naturally, many kinds of vessels will be operated through the canal. A ship chartered for a single trip or for a limited period may be any available vessel capable of performing the transportation service desired by the charterer. Bulk carriers will be operated both as lines and as single vessels for the transportation of bulk cargoes of coal, ore, nitrate, fuel oil, lumber, grain, and similar products. Doubtless many corporations and individuals shipping bulk cargoes will own, or operate under time charters, such vessels as they require for the marketing of their products.

For the transportation of such bulk cargoes as coal, ore, and grain, when shipments are made regularly and in large volume, special types of vessels such as turret and trunk steamers are used to some extent. For shipping oil in bulk, tank steamers are employed. Figures 17, 18, and 19 illustrate the general design of turret and trunk steamers.

The turret ship is so named because of the turret-like erection extending the entire length of the vessel. The upper, or turret, deck, as is shown in figure 17, is narrower than the harbor or main deck. "The sides of the turret are blended into the harbor deck, and the harbor deck into the vertical side plating by well-rounded corners." (Walton's Present Day Shipbuilding, p. 70.) The hatches, superstructures, and accommodations for officers and crew are on the turret deck. The construction of the hull may follow various designs, and the turret ships may differ materially in details of construction. The midship section given in figure 17 shows a deep hold with two rows of hold pillars, and with a lower deck. By strengthening the framing, the lower deck, or, if preferred, both the lower deck and the hold pillars may be dispensed with. In some vessels all decks below the turret deck are done away with, and the interior of the

FIG. 15. MIDSHIP SECTION OF FREIGHT STEAMER, PANAMA CANAL SERVICE.



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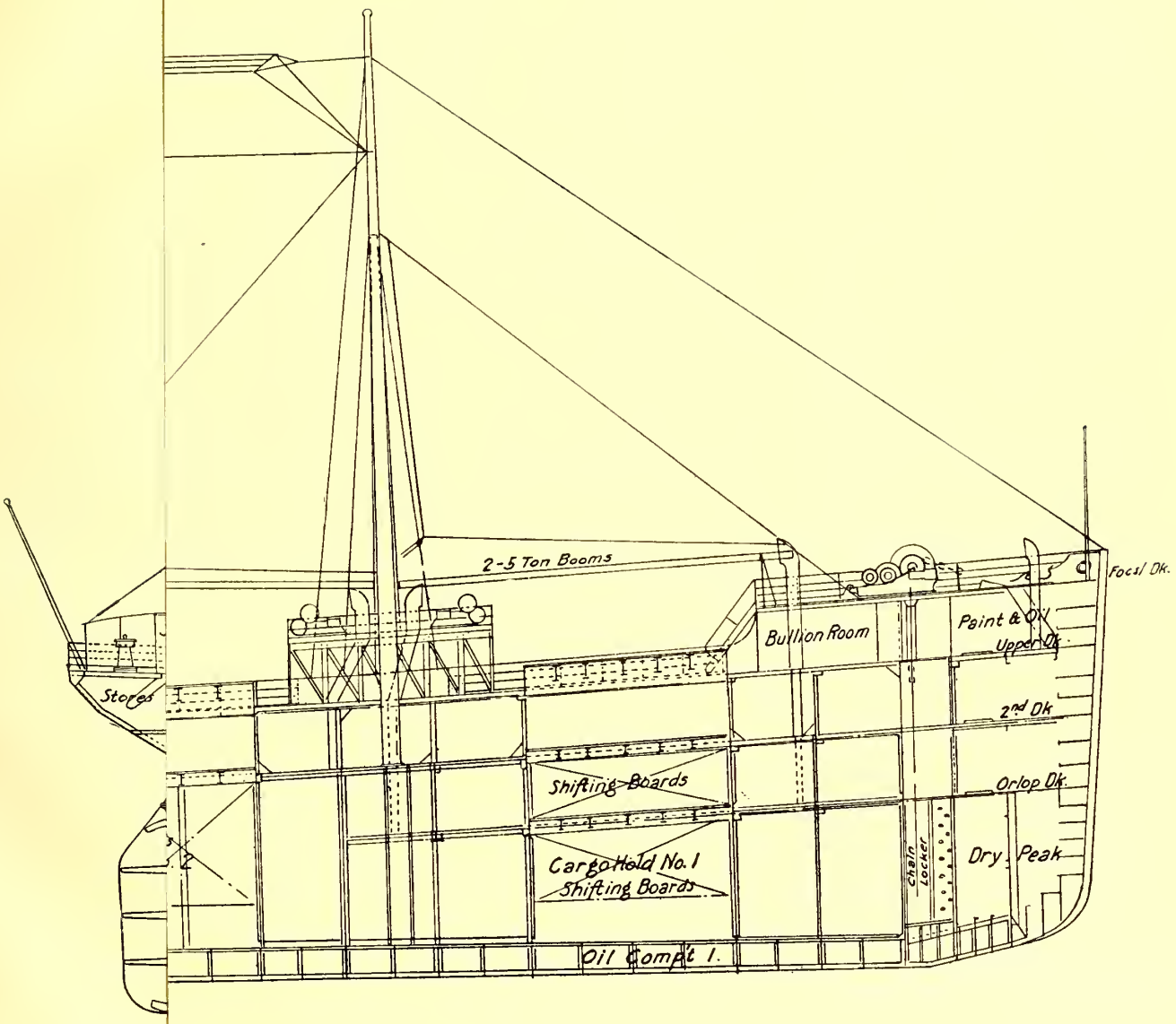
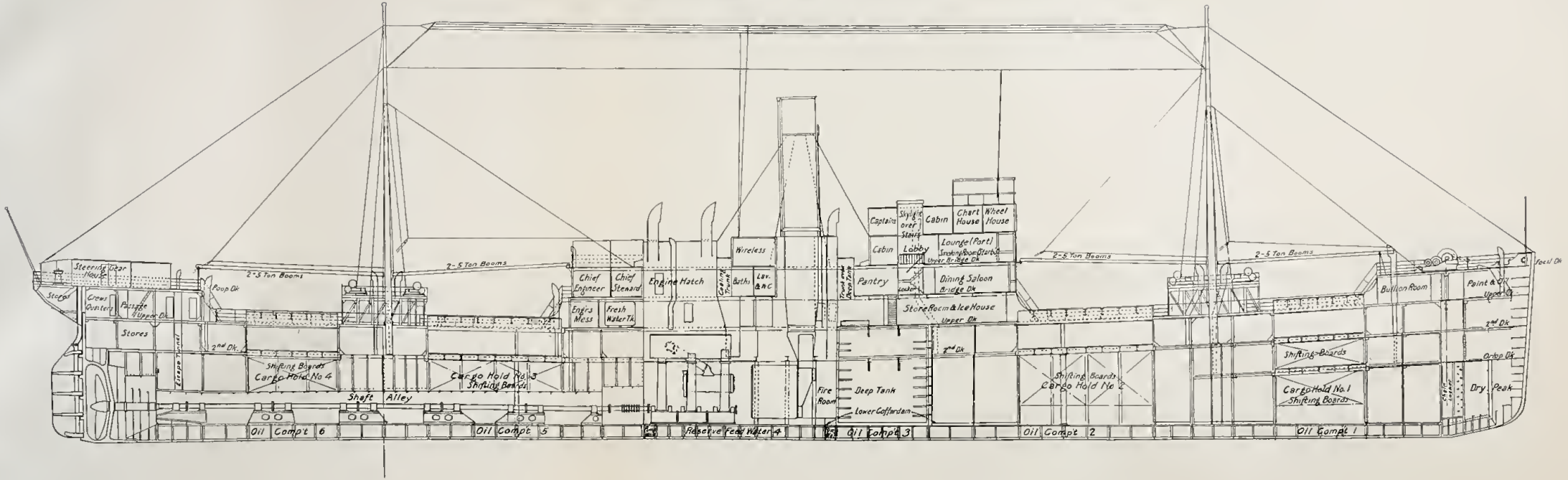

2-5 Ton Booms
Focsl Dk.
Bullion Room
Paint & Oil
Upper Dk.
2nd Dk
Orlop Dk.
Stores
Shifting Boards
Cargo Hold No. 1
Shifting Boards
Chain Locker
Dry Peak
Oil Compt 1.

61861°

FIG. 16. PROFILE OF FREIGHT STEAMER, PANAMA CANAL SERVICE.



hull is without obstructing pillars or decks. Such vessels require specially strong framing to afford the necessary strength of hull.

A turret vessel constructed with lower and harbor decks, as shown in figure 17, is well adapted to the stowage of heavy bales and packages and of miscellaneous weight cargo; while

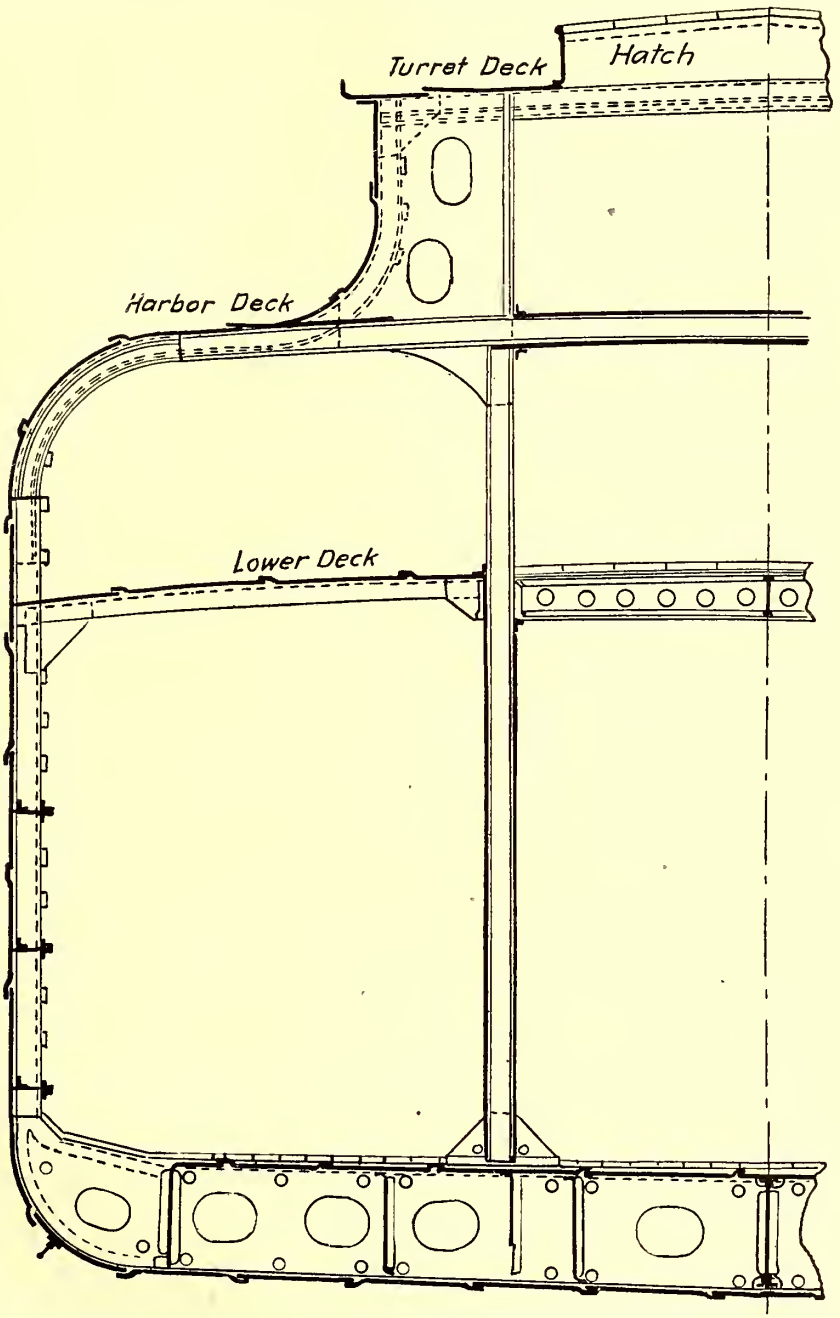


FIGURE 17.—Midship section of turret steamer with lower and main (harbor) decks.

a turret ship without pillars and without decks below the turret is well designed for the transportation of bulk cargoes of grain, lumber, and ore.

A self-trimming turret steamer is illustrated by figure 18, which gives a view of the hold of an ore ship in which the engines are placed aft and in which there is an unobstructed hold extending all the way from the collision bulkhead to the boiler-room bulkhead. The hatches

are continuous over the entire length of the hold. Such a vessel may also be used to advantage for the shipment of coal, lumber, or other bulk cargoes.

A type of vessel known as "whaleback" is in some respects similar to a turret-deck vessel, but the number of whalebacks likely to use the Panama Canal is too small to warrant the reproduction of deck plans, cross sections, or longitudinal profiles. Both whaleback and turret vessels dispense with fore and aft sheer, both are designed for bulk cargo, and the gunwale

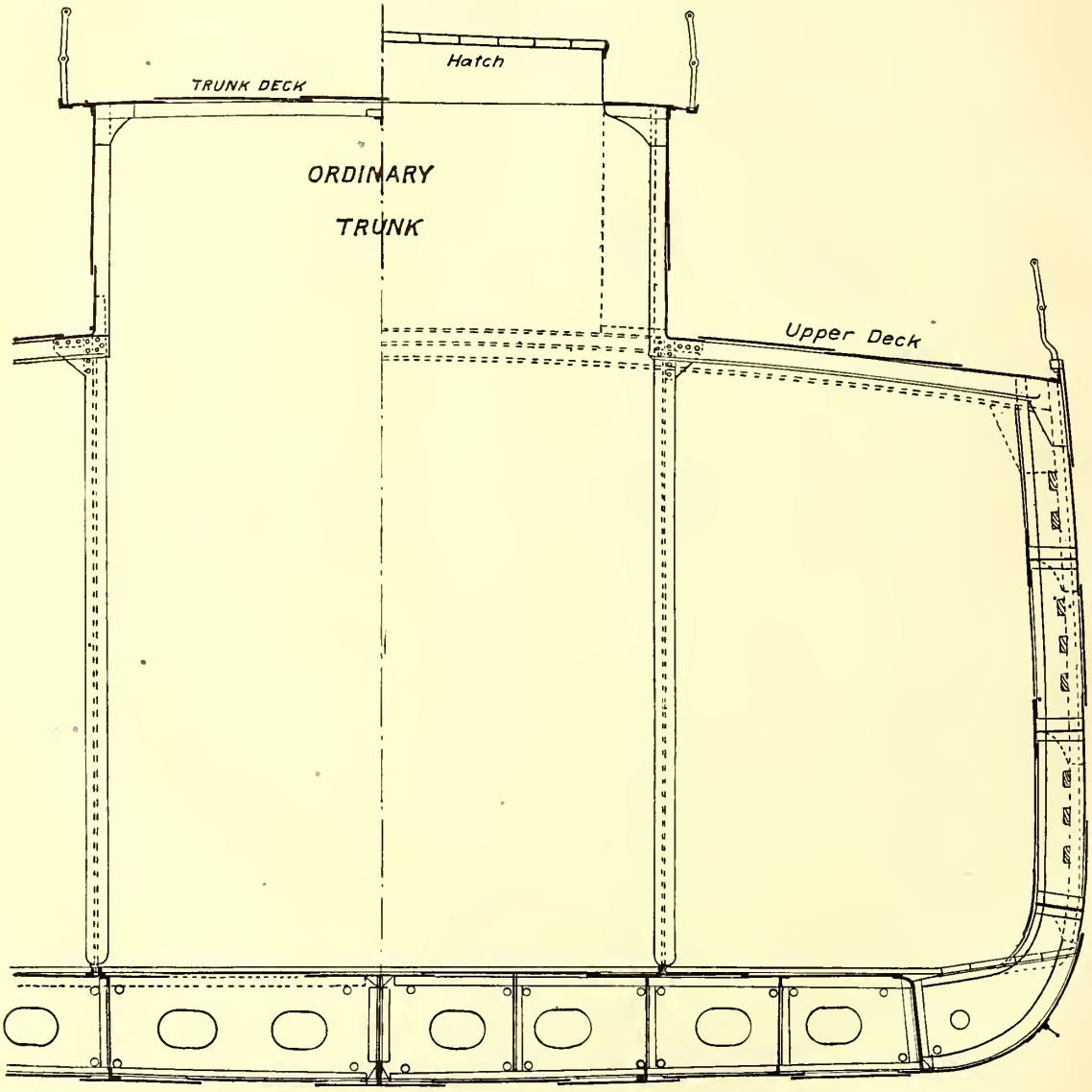
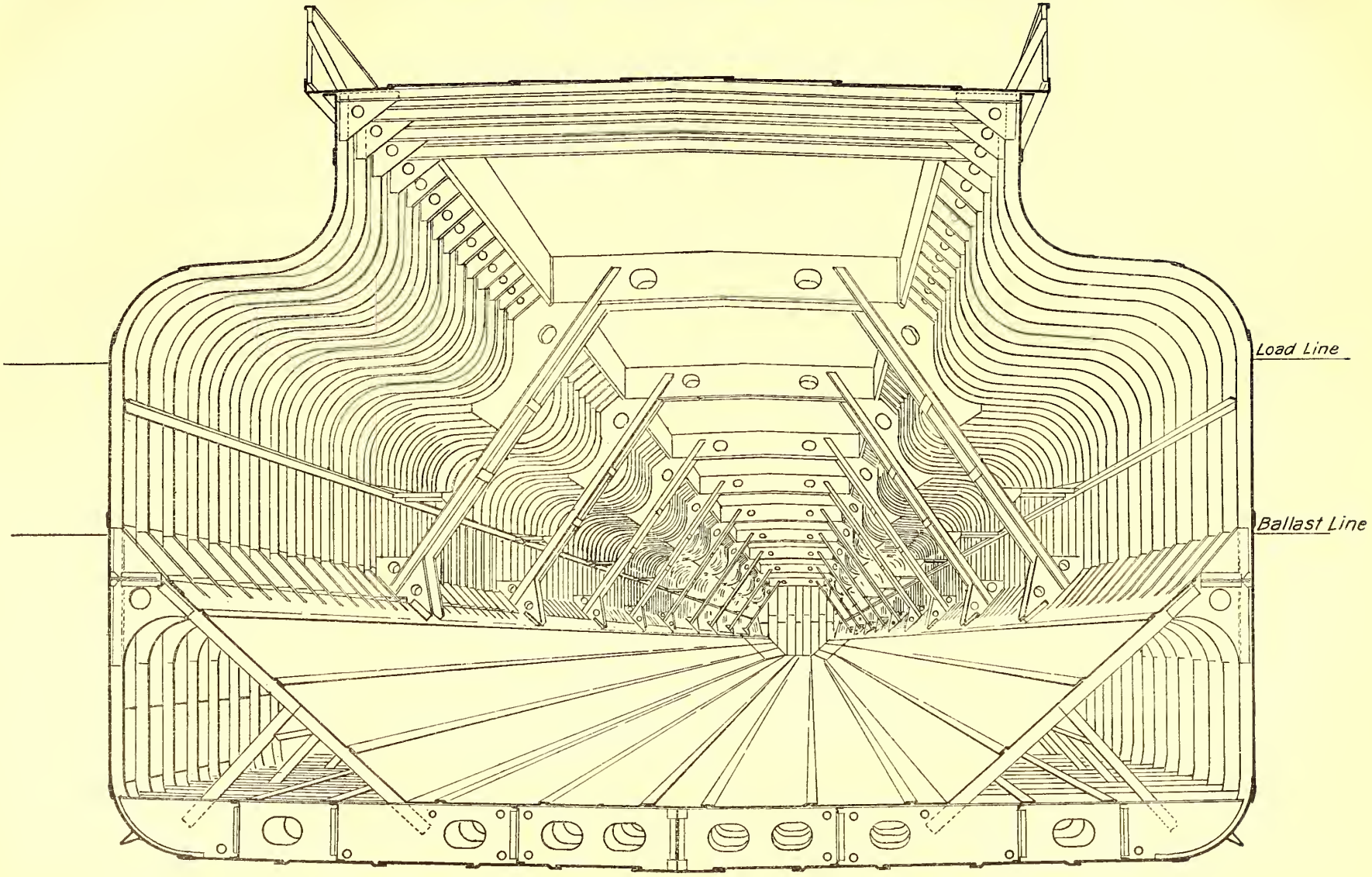


FIGURE 19.—Midship section of trunk steamer.

is of rounded form in each case. The whaleback steamer, however, differs from the turret-deck vessel in that it aims to provide absolutely clear decks without deck erections and with a rounded form which breaks the force of the sea. It was found that it is difficult for the crew to man such a deck in heavy seas, that the hatchways without coamings interfere with feeding the holds with bulk cargoes, and that the shape of the bow and bottom "makes the hull specially liable to damage when the vessel is pitching in a seaway, owing to the pounding action

FIG. 18. HOLD VIEW OF SELF-TRIMMING TURRET STEAMER.



produced as the vessel thumps against head seas." [1] Relatively few whalebacks are in operation while the turret steamers, on the contrary, are rapidly increasing in number.

The trunk steamer is another special type of bulk carrier without a lower deck. Its general design is indicated by figure 19. There is above the upper deck a trunk erection which is 7 feet high and half the width of that deck. This trunk connects the forecastle with the bridge and the bridge with the poop. The hold is clear except for widely spaced pillars which extend from the floor of the hold to the angle formed by the upper deck beams and the frames of the sides of the trunk. One-half the pillar may be carried up the side of the trunk and be riveted to the plating. The upper deck beams do not extend across the ship; but strong crossbeams, in such number as the strength of the ship requires, are placed across the open portion of the upper deck. With the exception of the crossbeams the hold is clear below the hatchways which are in the trunk deck.

Turret and trunk steamers, being especially intended for dead-weight and bulk cargoes, have a relatively small freeboard below the harbor and upper decks, but the turret and trunk

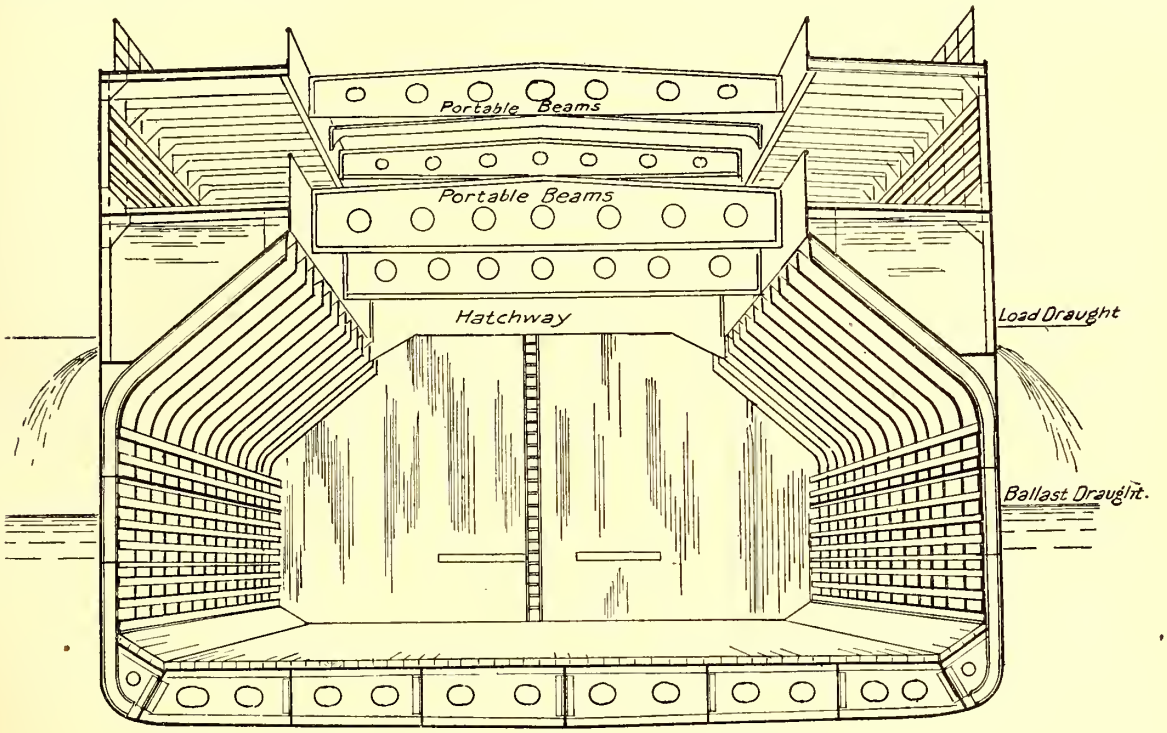


FIGURE 20.—Hold view, self-trimming three-deck steamer.

decks from which the ships are navigated are well above the water line. When the hold and the trunk are filled with grain or other bulk cargo that may come, by settling, to occupy less space, the cargo in the turret or trunk feeds into the hold, which is kept filled, and thus there is no danger that a shifting of the cargo may give the vessel a dangerous list. Lumber or other deck cargo not injured by the sea is sometimes carried upon the harbor deck of the turret steamer and upon the main (or upper) deck of the trunk steamer.

There are other types of self-trimming steamers than the self-trimming turret and trunk steamers above mentioned. The principles of a clear hold without a lower deck, lower deck beams, pillars, or other hold obstructions, and with arrangements to facilitate the trimming of bulk freight are applied to vessels which have their walls carried to the upper deck without turret or trunk arrangement. Figure 20, for example, shows the hold view of a self-trimming vessel, which does not differ externally from any ordinary steamer. This particular vessel has water-ballast tanks between the self-trimming frames and the walls of the ship, which bring

[1] Walton, Present-Day Shipbuilding, p. 69.

its water-ballast capacity to nearly a third of the total dead-weight carrying capacity of the ship. It is essential that measurement rules should deal fairly with those water-ballast spaces which are not available for cargo; while, in case of turret and trunk steamers, the rules should ully account for the inclosed turret and trunk deck spaces which constitute parts of the cargo capacity.

Tank steamers are largely used for the transportation in bulk of petroleum and of some other oils. The fluidity of oil in bulk and the danger of explosion from the gases formed of petroleum require a special construction of tank steamers to make them stable and safe. The part of the hold occupied by the oil in bulk is subdivided into small tanks; first, by a strong longitudinal bulkhead extending the entire length of the ship above the center line of the vessel and rising to the uppermost deck; second, by transverse bulkheads spaced about 24 feet apart. The small tanks thus formed being filled with oil when the vessel is loaded, the fore-and-aft and side-to-side movement of the oil due to the pitching and rolling of the vessel at sea is reduced to a minimum. To provide for the expansion of petroleum, due to increase in temperature, and to prevent explosion, due to forming of gases, an expansion trunk or space is placed 'tween decks between each oil tank and the hatch opening into the tank.

The general plan of a typical large oil tank steamer is shown in figures 21, 22, and 23.

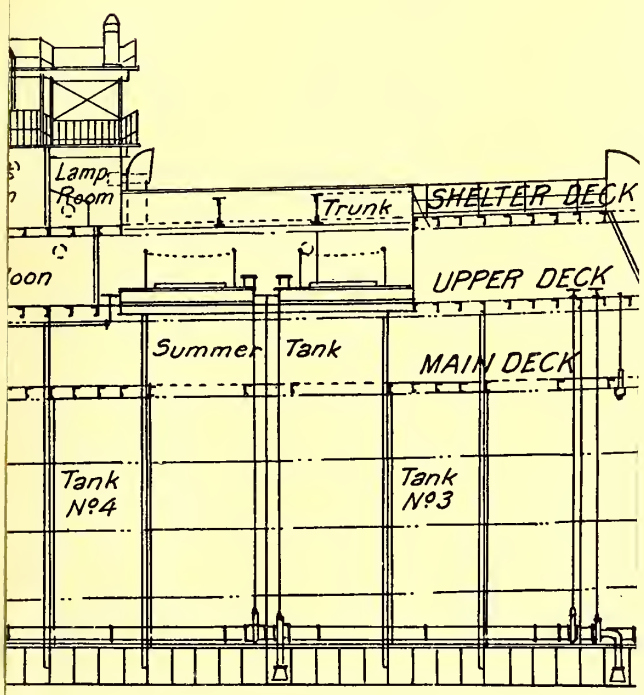
The plans of the oil steamer illustrated by figures 21, 22, and 23 show that the tanks are placed amidships with the engines aft. There is a small cargo hold forward of the tank. Between the tanks and the cross bunker adjacent to the engine room are two water-tight bulkheads spaced a few feet from each other to provide a cofferdam between the tanks and the engine room. A similar cofferdam is placed between the cargo hold and the oil tanks. These cofferdams may be filled with water or kept empty, their purpose being to prevent the escape of gases from the oil tanks to the engine room or to the cargo hold. Coal or fuel oil for the engines may be carried in the reserve bunkers located between the expansion trunk and the outer shell of the ship. The vessel has four decks—a lower, which is dispensed with, a main, an upper, and a "shelter" deck. The "shelter" deck, however, is without tonnage openings and is a shelter deck only in name. The space between it and the upper deck, not occupied by expansion trunks, is available for fuel, freight, stores, crew quarters, and officers' accommodations. As indicated in figure 21, various superstructures, such as the galley, smoking room, chart room, and lamp room are located above the shelter deck. Some of the space between the main and upper deck is taken up by so-called "summer tanks," which are used for stowing oil during the warmer seasons. These summer tanks are constructed and tested as required for ordinary oil compartments and are likewise fitted with expansion trunks.

Figure 24 contains the deck plan and longitudinal profile of an oil tank vessel equipped with Diesel oil engines. This vessel has but three decks—a lower deck, which is dispensed with, an upper deck, and a shelter deck; and it has no summer tanks. Above the "shelter" deck is a long poop surrounding the light and air casing above the engine room. The space in the poop is used for living quarters.

The special feature of this vessel is the engine and fuel arrangement. There is no boiler room because Diesel engines are of the internal-combustion type. The engine room is larger than would be necessary to hold the engines, it being enlarged sufficiently to bring its volume somewhat over 13 per cent of the vessel's gross tonnage in order thereby to entitle it to a power deduction of 32 per cent of the gross tonnage under the measurement rules of Germany. The fuel oil is carried partly in fuel tanks and partly in double-bottom compartments below the engine room. The total fuel space is very much less in volume than it would be were the ship fitted with steam engines burning either oil or coal.

Figure 25 illustrates a combination freight and passenger vessel fitted with Diesel engines. It is 370 feet long, of 53 feet beam, 9,800 tons displacement, and 7,400 tons cargo capacity. It is mainly a general cargo vessel, but has accommodations for 20 passengers, and has a speed of 11½ to 12 knots. Aside from the engine-room arrangement, which is similar to that shown in the preceding figure, and the absence of boilers, this vessel illustrates various additional phases of ship construction and tonnage measurement. (1) The usual smoke funnels are dispensed

IER.


Lamp Room
Trunk
SHELTER DECK
UPPER DECK
Summer Tank
MAIN DECK
Tank No4
Tank No3

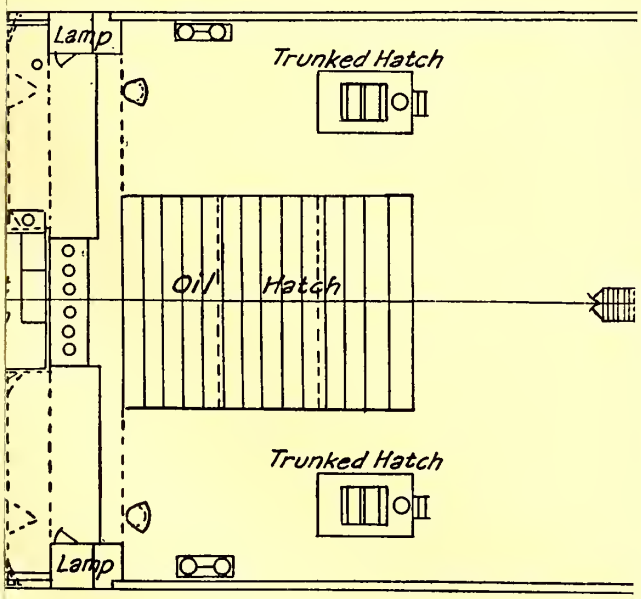

Lamp
Trunked Hatch
Oil Hatch
Trunked Hatch
Lamp

FIG. 21. ELEVATION AND DECK PLAN OF AN OIL TANK STEAMER.

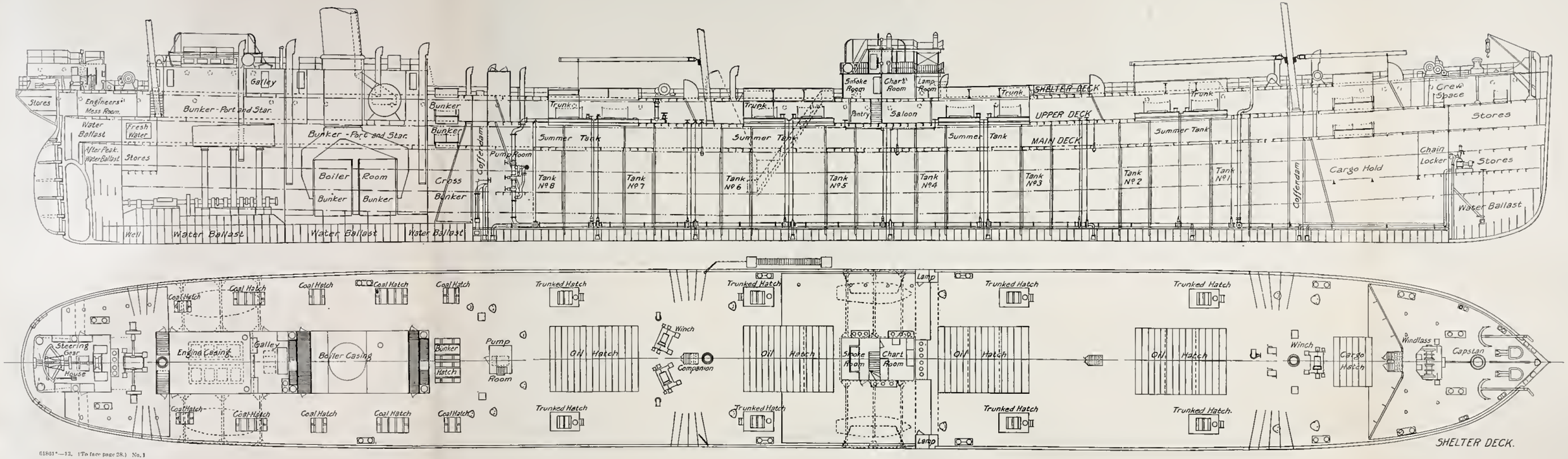


FIG. 22. MIDSHIP SECTION OF AN OIL TANK STEAMER.

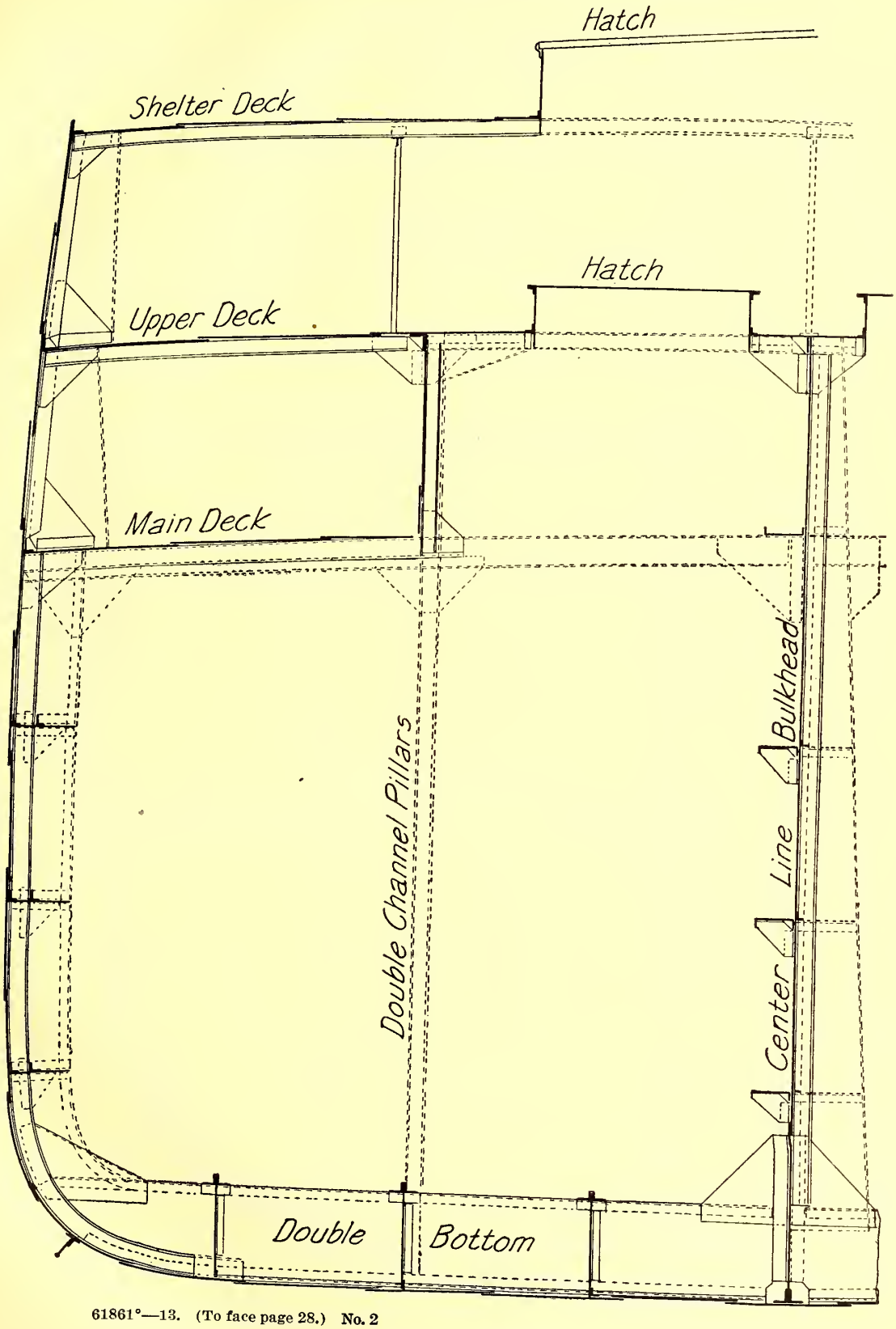


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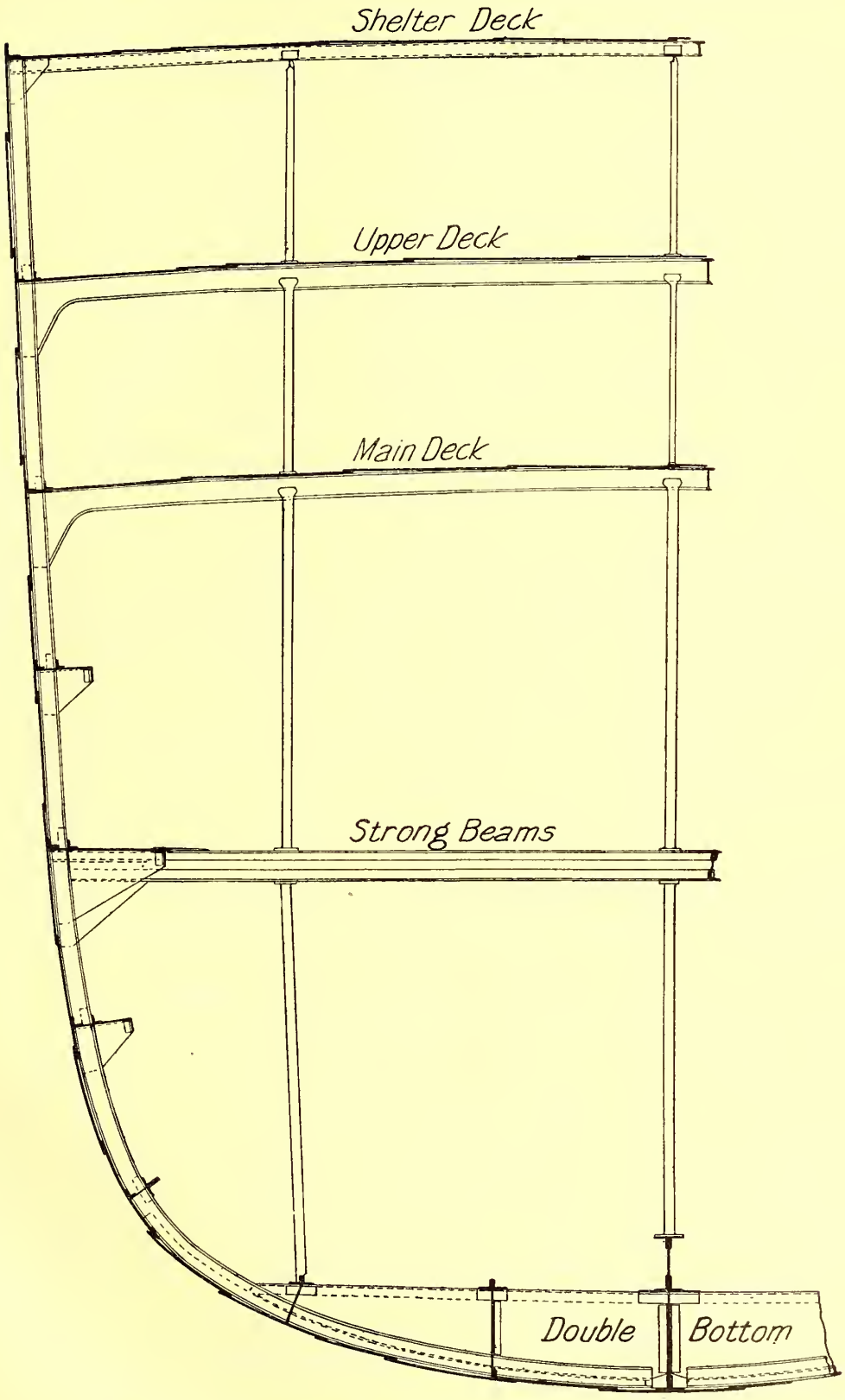
FIG. 23. SECTION IN WAY OF FOREHOLD OF AN OIL TANK STEAMER.



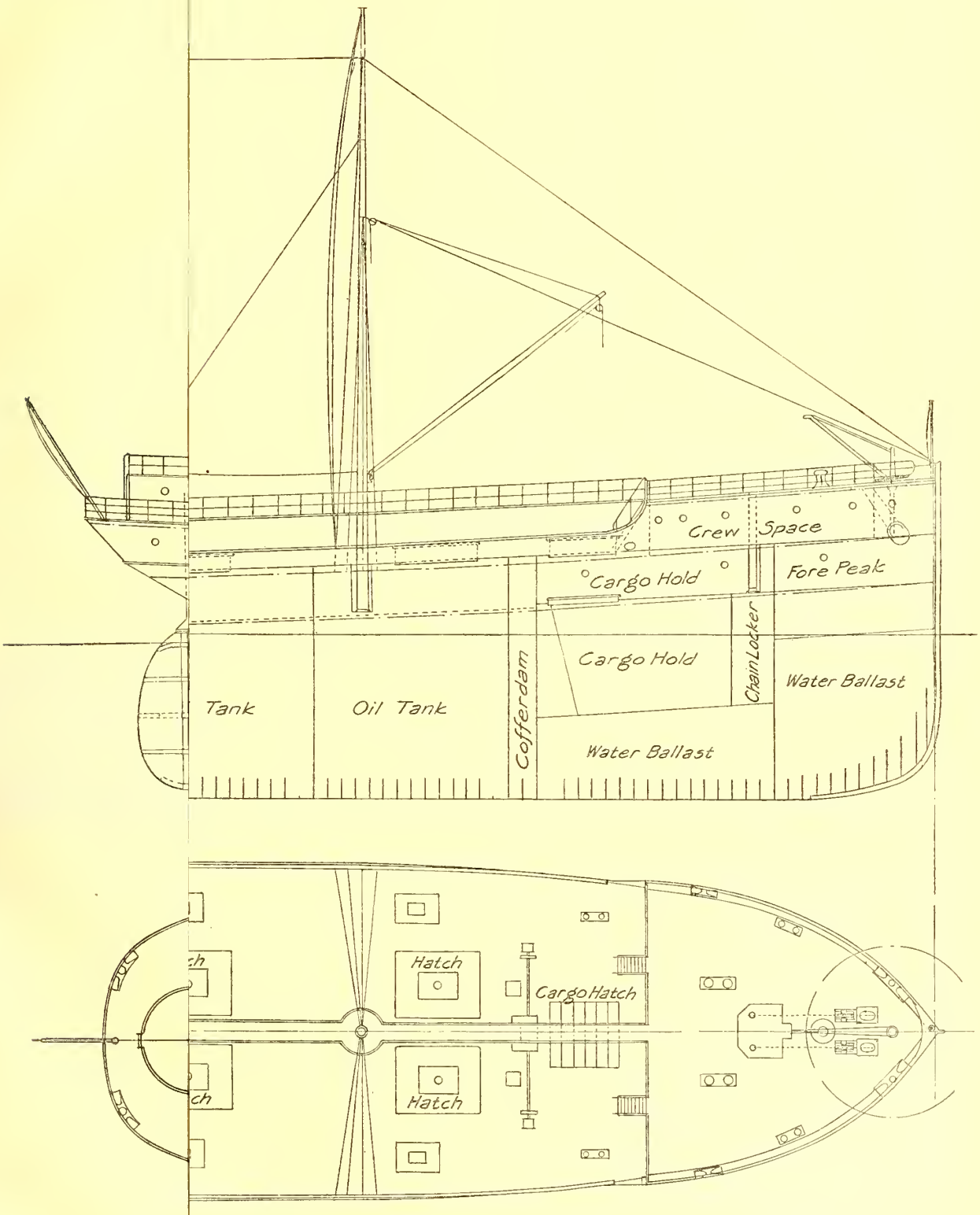
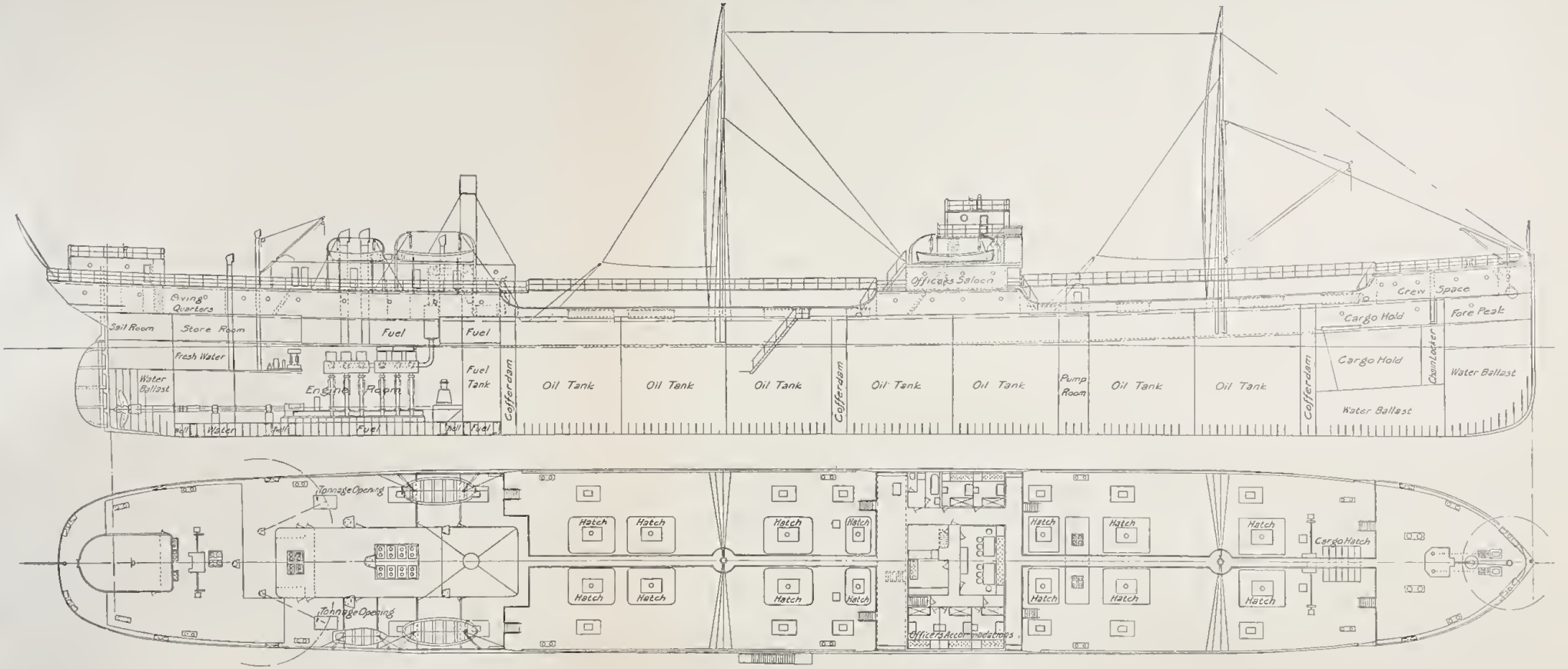
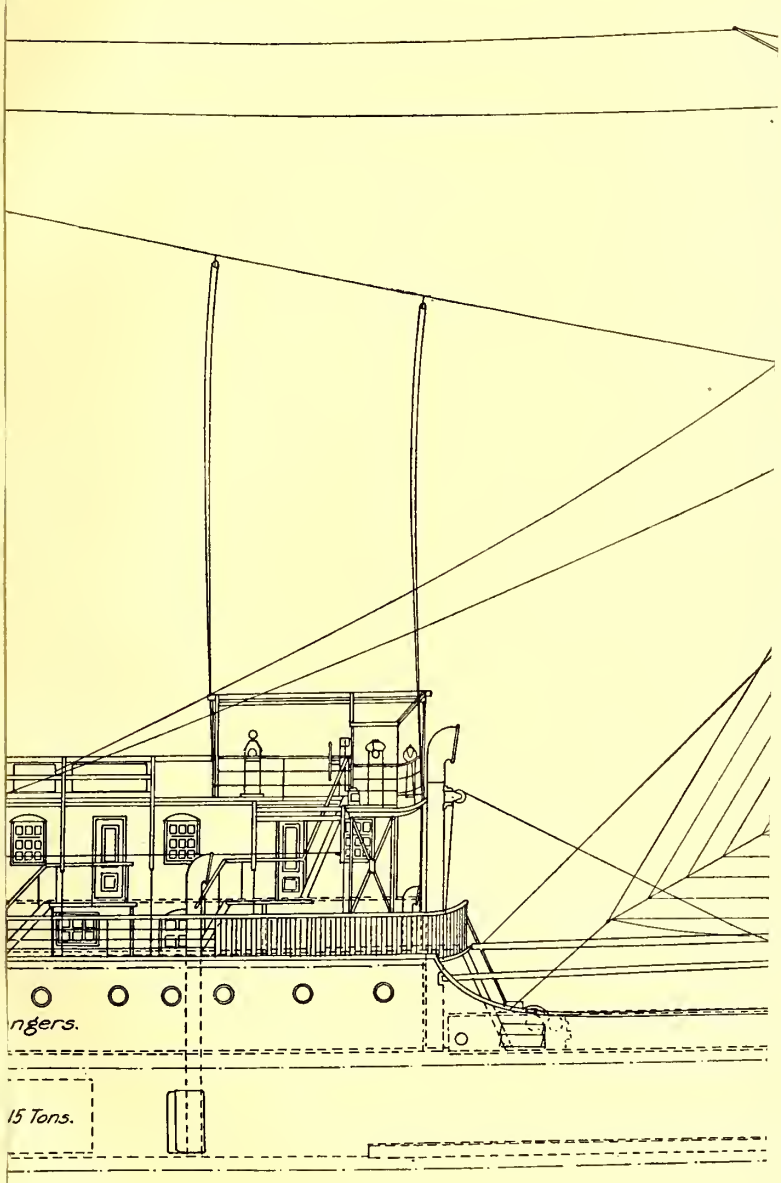

Crew
Space
Cargo Hold
Fore Peak
Cargo Hold
Chain Locker
Water Ballast
Tank
Oil Tank
Cofferdam
Water Ballast
Hatch
Cargo Hatch
Hatch

FIG. 24. PROFILE AND UPPER DECK PLAN OF OIL TANK CARRIER WITH DIESEL ENGINE.

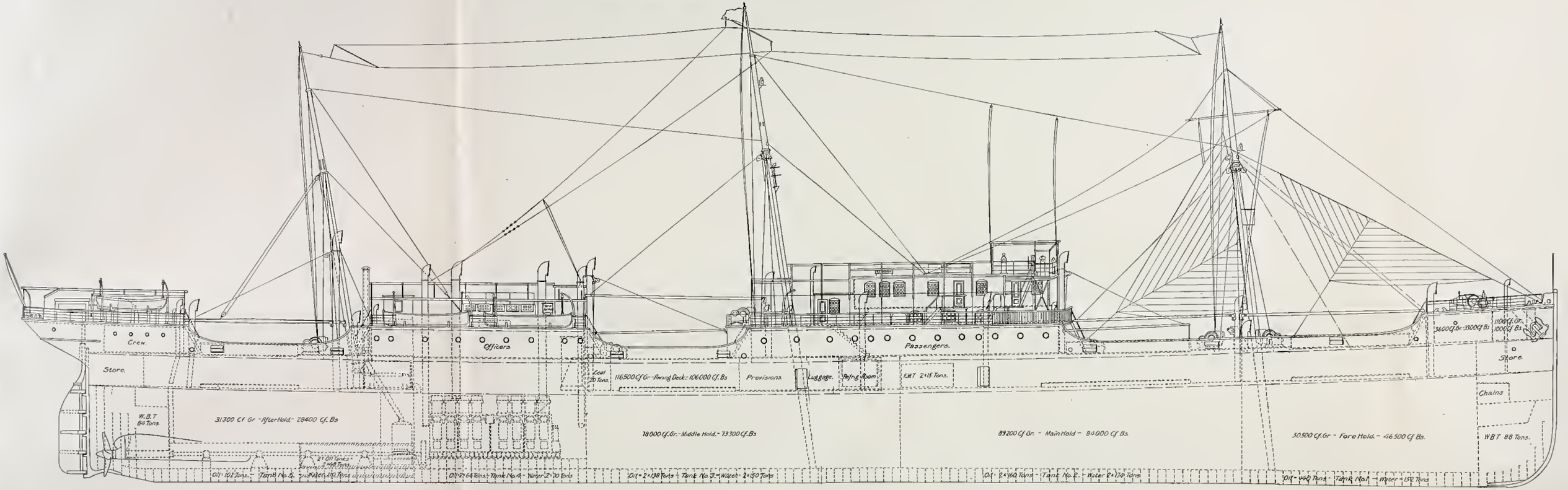


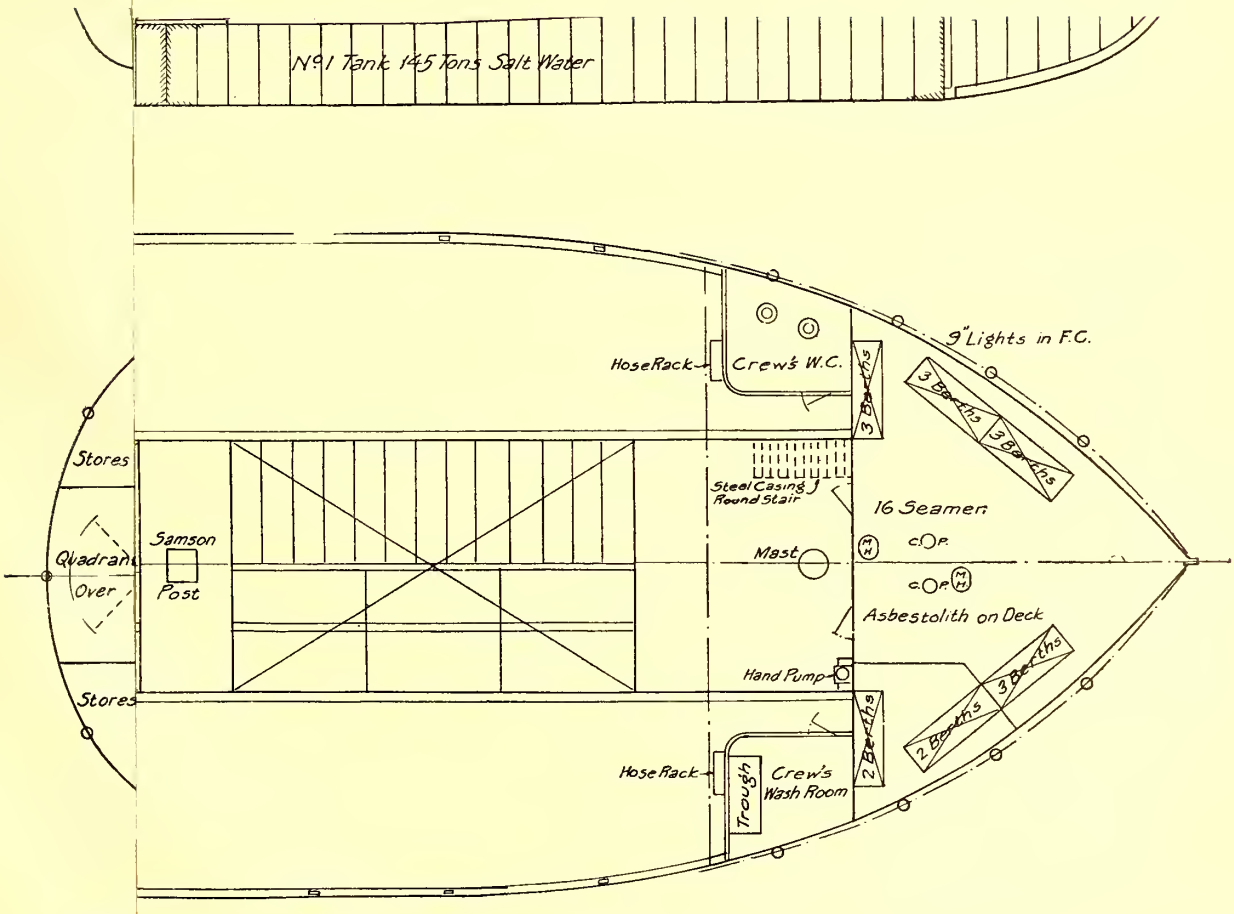


89200 Cf. Gr. – Main Hold – 84000 Cf. Bs.

Oil – 2×160 Tons – Tank No. 2. – Water 2×174 Tons.

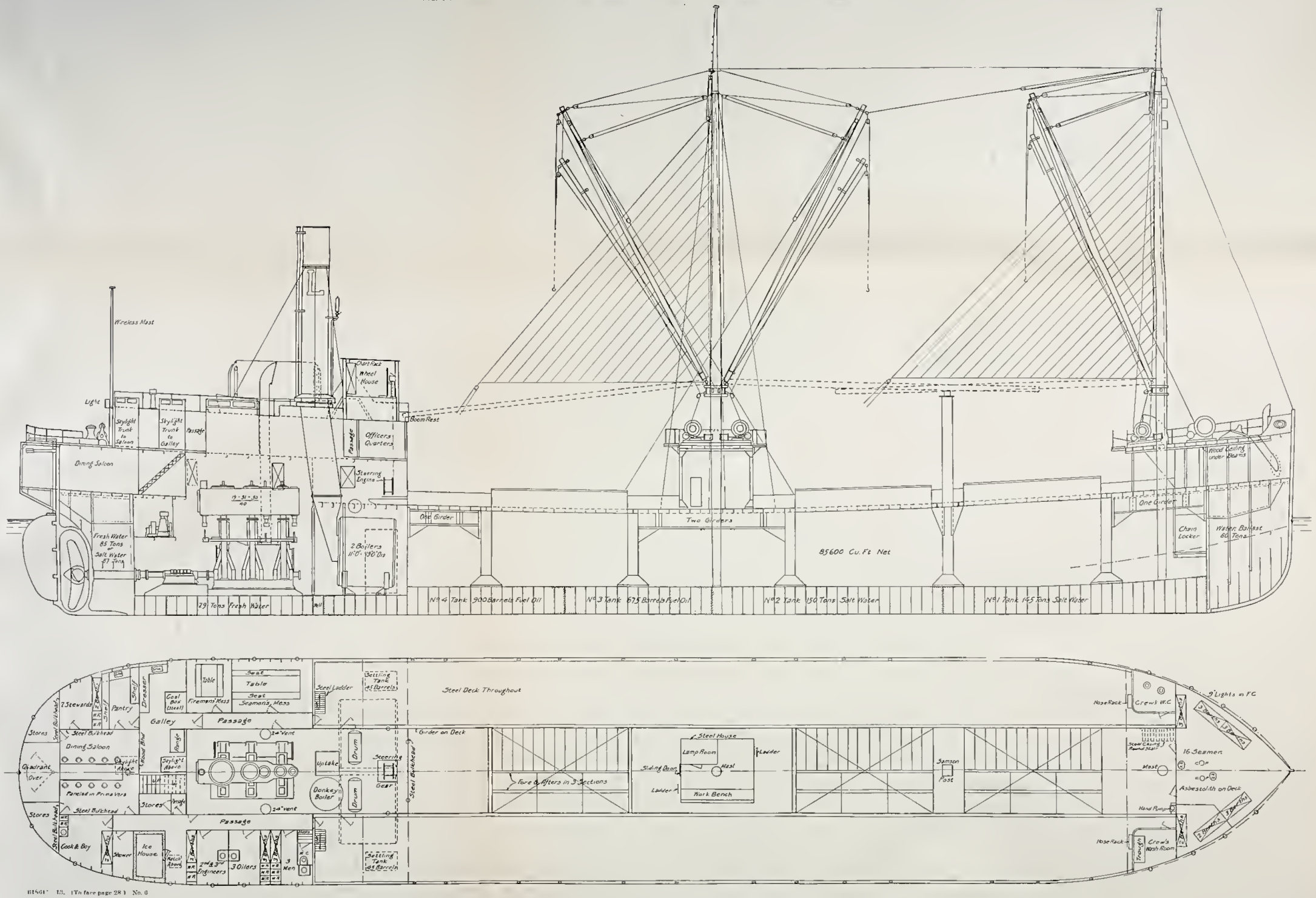
FIG. 25. PROFILE OF CARGO VESSEL WITH SMALL PASSENGER ACCOMMODATIONS, DIESEL ENGINES.


Crew.
Store.
Officers
Passengers.
Coal 120 Tons.
116500 Cf Gr - Awng Deck - 106000 Cf Bs
Provisions.
Luggage.
Bathing Room
LWT 215 Tons.
3600 Cf Gr - 3300 Cf Bs
1100 Cf Gr. 1000 Cf Bs
Store.
Chains
W.B.T 84 Tons.
31300 Cf Gr - After Hold - 28400 Cf Bs
78000 Cf Gr - Middle Hold - 73300 Cf Bs
89200 Cf Gr - Main Hold - 84000 Cf Bs
50500 Cf Gr - Fore Hold - 46500 Cf Bs.
W.B.T 88 Tons.
Oil - 101 Tons - Tank No 5 - Water 110 Tons
Oil - 64 Tons - Tank No 4 - Water 210 Tons
Oil - 2 x 138 Tons - Tank No 3 - Water 2 x 150 Tons
Oil - 2 x 160 Tons - Tank No 2 - Water 2 x 170 Tons
Oil - 140 Tons - Tank No 1 - Water 152 Tons


No 1 Tank 145 Tons Salt Water
9" Lights in F.C.
Hose Rack
Crew's W.C.
3 Berths
3 Berths
3 Berths
3 Berths
Steel Casing Round Stair
16 Seamen
Stores
Samson Post
Quadrant
Over
Mast
C.O.P.
C.O.P.
Asbestolith on Deck
Hand Pump
Stores
3 Berths
3 Berths
2 Berths
Hose Rack
Trough
Crew's Wash Room

61861°

FIG. 26. PROFILE OF "STEAM SCHOONER" FOR WEST COAST UNITED STATES LUMBER TRADE.



with; (2) the crude fuel oil used to operate the engines is stowed in the double bottom; (3) two 12-ton working tanks are provided, sufficient oil for a 24-hour run at full power being pumped from the double bottom into these tanks for current use in the cylinders. The importance of internal-combustion engines in tonnage measurement is fully discussed in Chapter X.

A type of bulk-cargo vessel which has become an important factor in the lumber trade on the Pacific coast of the United States is the so-called "steam schooner." Originally, these vessels were the outgrowth of sailing schooners, a number of schooners being fitted with engines. Indeed, some of the steam schooners now in service still carry sails for occasional use. The modern steam schooner, however, is a steamer, depending wholly upon its engines, the name being retained because of the vessel's origin and because of its general construction. In a paper by Mr. Frank W. Hibbs, read before the Association of Naval Architects and Marine Engineers, New York, steam schooners are described as follows:

> The vessels are built similarly to the sailing schooner, with greater proportionate beam than the ordinary steamer, with high freeboard, great sheer forward, a topgallant forecastle and raised quarter deck. There is a midship deckhouse over the machinery, with a very high bridge deck, leaving large clear gangways on the main deck, and a small deck house on the bridge deck, with a small passenger accommodation. They have low power and are built to very heavy scantlings, and are the stanchest vessels that are seen on the coast. They carry large deck cargoes of lumber, and are regarded as the most profitable type of coasting cargo vessel.

Steam schooners are ordinarily fitted with low-powered oil or coal burning steam engines.

Figure 26 contains the longitudinal profile of a typical steam schooner used in the lumber trade of the Pacific coast. Its length is 235 feet, its beam 42½ feet, and its molded depth 18 feet 8 inches. Its gross tonnage, American register, is 1,600 tons, and its net tonnage 915 tons. The net tonnage is small as compared with ordinary cargo steamers, because it is constructed to carry much cargo on the open deck. The engine room is constructed so as to be in excess of 13 per cent of the gross tonnage, thereby resulting in a deduction of 32 per cent for propelling power and fuel. Its engines are designed to burn oil, some of the oil being carried in the aft double-bottom compartment, and some in portable settling tanks on each side of the boilers. Should this vessel make long voyages through the canal, additional oil would be stowed in the forward double-bottom tanks and in the fore peak water ballast tank.

The vessel has but one full-length deck, although there are two short decks aft, the spaces under which being occupied by officers' quarters, galley, saloon, pantry, light and air casings, funnel, etc. The entire fore part of the vessel, with the exception of the forecastle, is used to stow cargo, and the open deck between the forecastle and the short decks aft is used to carry great volumes of deck cargo, the vessel being designed to transport 1,500,000 feet of lumber. The advisability of measuring or exempting deck loads is of special importance in the measurement rules applicable to steam schooners, as it is not unlikely that some of them will pass through the Panama Canal with cargoes of Pacific coast lumber.

The foregoing description includes the leading types of vessels that will use the Panama Canal. The plans and profiles locate most of the spaces referred to in the following discussion of tonnage and vessel measurement. In the report recently submitted in 1912, upon Panama Canal Traffic and Tolls, it was recommended that merchant vessels be required to pay Panama tolls upon their net tonnage and that the charges upon warships should be upon their displacement. The proclamation issued by the President November 13, 1912, fixed the tolls on merchant vessels at $1.20 per net ton—each 100 cubic feet—of actual earning capacity, and upon warships at 50 cents per displacement ton. The measurement rules embodied in the following report are drafted with a view to including in the net tonnage of vessel all spaces available for passengers or cargo—the tonnage of actual earning capacity. The plans and profiles presented in this chapter show what use is made of the several spaces within typical vessels, and thus indicate what spaces ought to be included in the net tonnage upon which the Panama charges shall be imposed.

The words "ton" and "tonnage" have many meanings. Before considering the problems of vessel measurement and the rules by which merchant ships using the Panama Canal shall be measured, it will be well briefly to define the several kinds of ton and tonnage and to explain why the Panama tolls should be levied upon the net tonnage of merchant vessels and upon the displacement tonnage of warships.

CHAPTER III.

CARGO TONNAGE, DISPLACEMENT, AND DEAD-WEIGHT TONNAGE.

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CARGO TONNAGE, DISPLACEMENT, AND DEAD-WEIGHT TONNAGE.

It is theoretically possible to make either the ships that use the canal or the cargo and passengers carried by the vessels the basis of Panama tolls. It is thus necessary first of all to decide whether the dues shall be levied upon the vessels themselves or upon their contents, and whichever decision is reached the problem still remains of selecting the best unit of measurement. For, while both the size of vessels and the amount of cargo they carry are designated in tonnage units, a vessel ton is different from a ton of freight. Moreover, there are three kinds of vessel tonnage and at least three meanings given to the word "ton" as a measure of ocean freight cargoes.

The purpose of this chapter is to explain the several units employed to designate the tonnage of cargo carried by vessels and to consider the merits and disadvantages of each as a basis for Panama tolls. One kind of vessel tonnage—displacement—is also defined and discussed in this chapter; because, as will be explained, one method of expressing cargo tonnage involves the determination of the vessel's displacement tonnage. The other two kinds of vessel tonnage—gross and net tonnage—will be discussed in turn in the two succeeding chapters.

Cargo tonnage may be of weight or of measurement. "Bulk" freight, like coal, ore, nitrate, grain, and heavy manufactures, is transported as weight cargo, a ton on the ocean being either the English long ton of 2,240 pounds (sometimes the short ton of 2,000 pounds) avoirdupois or the metric ton of 2,204 pounds. Package freight and commodities that are light in proportion to their bulk are often shipped as "measurement" cargo, 40 cubic feet usually being considered a ton. When possible, vessels are loaded partly with heavy bulk freight, which is placed lowest in the hold, and partly with light measurement cargo, which is stowed in available spaces above, as well as below, the main deck. The heavy commodities give the ship the draft necessary for stability, while the light package freight fills up the earning capacity of the ship without causing the vessel to exceed its authorized draft. A vessel loaded only with coal, ore, grain, or heavy steel will be immersed to its deep load line before the space available for cargo has been filled with paying freight. On the other hand, if a ship be laden only with package freight and light cargo, it may ride so high in the water as to be unstable. If heavy cargo is not available, the ship must be given stability by means of ballast. It is a paradoxical fact that a vessel can be loaded with more "tons" of light freight than of heavy bulk commodities, the ideal lading of a ship being the combination of bulk and package freight.

ADVANTAGES AND DISADVANTAGES OF CARGO TONNAGE AS A BASIS FOR CANAL TOLLS.

In selecting a basis for the levy of Panama tolls choice must be made between the ship and its cargo contents. The transfer of a vessel from the Atlantic to the Pacific through the canal is the service rendered to carriers engaged in the transportation of freight and passengers; but, as the revenues of the carrier are derived from the rates paid by shippers and the fares collected of the passengers, it seems to many persons logical that the charges exacted by the Government for the use of the canal should be placed upon passengers and cargo and not upon the ship. The advantages of making cargo the basis of canal dues may be summarized as follows:

1. It is claimed that canal tolls based upon the cargo and passengers carried in vessels will be in direct ratio to the carrier's ability to pay, because the charges will be levied upon the carrier's sources of income for the voyage that causes the carrier to make use of the canal. If the vessel making the trip through the canal is fully occupied by cargo and passengers, the income of the carrier will be large and the tolls he will pay for the use of the canal will be

proportional; while if the capacity of the vessel is but partially taken up, the revenues of the owners of the vessel will be small and the tolls required of them will be correspondingly less.

2. By placing canal tolls upon cargo and passengers, the levies will be put upon the same basis as are rail and ocean freight rates and passenger fares. The canal tolls will be a definite addition to the charges payable by the shipper and passenger for transportation from ports of shipment or departure to ports of destination. It should be stated, however, that this argument in favor of basing tolls upon cargo and passengers assumes that ocean rates and fares are controlled by competitive commercial forces and that the canal tolls, whatever they may be, are a burden which shippers and passengers will be required to bear. As a matter of fact, ocean rates and fares, like those charged for railroad transportation, are controlled by forces which are but partially competitive and which are in a large degree monopolistic. In so far as ocean rates and fares are controlled by monopoly forces, they will be made with reference to what the traffic will bear and not with regard primarily to expenses incurred in performing the transportation services. If ocean rates and fares are monopoly charges, they will not be directly affected by canal tolls and the charges paid by carriers for the use of the canal will be an operating expense which the carriers and not the shippers and passengers will have to meet.[1]

3. The third argument in favor of making cargo the basis of canal tolls is that the charges for the use of the canal would be, or could in theory be, graded according to the value of the different kinds of commodities, and that the charges could be made high on valuable articles and low on cheap bulky commodities. Concisely stated, the argument is that the tolls can be made what the different articles or classes of commodities can bear. By making commodities the basis of canal charges, the dues would be based upon the value of the service to the carriers, instead of being determined by the cost to the United States of performing the service of passing vessels through the canal.

This raises the broad and fundamental question whether the value of the service to those who use the canal or the cost of the service to the canal administration, which in this case will be the United States Government, should be the controlling consideration in fixing canal charges. It is generally assumed that the canal tolls, as in the case of other Government charges, are to be, and ought to be, levied for the purpose of meeting, first of all, the expenses incurred by the Government in operating and maintaining the canal. There may possibly be some difference of opinion as to the advisability of fixing the Panama tolls at rates high enough to yield revenues that will cover not only maintenance and operating expenses but also interest and amortization charges; but there has been no serious doubt as to the wisdom of securing from the Panama tolls the revenues necessary to cover the expenses of operating and maintaining the canal, of the sanitation and government of the Canal Zone, and of meeting the $250,000 annuity payable to the Republic of Panama. The tolls ought at least be sufficient to cover current expenses.

Whether the fixed charges required to meet the interest upon, and the amortization of, the funds invested shall be secured from the current revenues from tolls is a question that must be decided in the light of experience obtained in the operation of the canal. The traffic of the canal fortunately promises to be large enough to enable the Government to maintain a schedule of tolls that will neither unwisely restrict the use of the canal nor unduly burden commerce, but which will yield revenues that will make the canal commercially self-supporting. The probable deficit during the early years of the canal's operation will, with the maintenance of reasonable rates of toll, be converted, by the growth of traffic during the first decade, into a slight surplus in excess of current expenses and fixed charges.

The natural and logical basis of charges for Government services is the cost of performing the service, and unless some exceptional conditions make it desirable to fix Panama tolls upon some basis other than the expenses due to construction, operation, and maintenance of the canal, it would seem wise to give main consideration to cost of service, i. e., to outlay for current expenses and fixed charges in levying Panama Canal dues. However, while adhering to

[1] For fuller consideration of the incidence of canal tolls, see pp. 197–198 of the Report upon Panama Canal Traffic and Tolls, by Emory R. Johnson, Government Printing Office, Washington, 1912.

the general principle of fixing Panama tolls with reference to operating and fixed charges, care should be taken so to adjust the charges that they shall not be higher than the traffic geographically tributary to the Panama route will bear. The tolls should not be what the naturally tributary traffic will not bear. With this limitation as to the maximum within which the charges must be kept, primary consideration should be given to cost of service in adjusting Panama Canal charges.

REASONS FOR NOT BASING PANAMA TOLLS UPON CARGO TONNAGE.

For the following reasons it is believed that cargo tonnage is neither a desirable nor a practicable unit upon which to levy Panama Canal tolls:

1. If tolls are to be fixed primarily with reference to the Government's canal expenses, the logical basis for the charges is the ship that uses the canal. The service performed by the Government is that of furnishing and operating a canal whose channel, locks, lights, buoys, and auxiliary appointments enable vessels to pass from one ocean to another. Each transit of a vessel through the canal represents the performance by the Government of a unit of service, and it is this service for which the Government makes charges. Vessel tonnage rather than the contents of the ship is the natural and logical basis for canal dues.

2. The primary purpose of making cargo the basis of canal tolls is to levy charges which vary according to the ability of different commodities to pay dues. The rates would necessarily vary with articles or classes of articles; for, if all commodities were charged the same rate of toll per ton the discrimination against coal and other minerals, nitrate, grain, lumber, and similar commodities, as compared with high-valued and relatively light package freight, would be so unjust as to be indefensible. The discrimination resulting from charging the same rate of toll upon each ton of all articles carried would be much greater than that resulting from tolls based upon vessel tonnage, i. e., the cubical contents of a vessel's earning capacity. In order to avoid unjust discriminations in levying tolls upon cargo it would be necessary carefully to classify ocean freight and to work out a schedule of class rates relatively reasonable as between the several classes of commodities. Doubtless some commodities, as in the case of railway traffic, would be exempted from this classification and would be charged special, or commodity, tolls. The canal tolls would thus include class and commodity rates, and the tolls payable by each vessel would have to be determined by calculating from the ship's detailed manifest of cargo the tonnage of each class of goods contained in its lading.

3. The necessity of classifying ocean freight traffic and of collecting tolls in accordance with a schedule which includes both class and commodity rates suggests the controlling reason why the ship rather than the cargo should be made the basis of Panama tolls. Canal charges based upon cargo would be administratively impracticable:

(*a*) The classification of ocean freight would be difficult to work out and would constitute a perennial problem. The railroads have found by experience that the classification of freight is second in difficulty only to the adjustment of rates, and this, too, under transportation conditions more stable than prevail upon the ocean. Classification of freight and the making of rates are inseparably connected, and without the stable rates resulting from the Government regulation of railroads and without the adjustment of the interrelations of railway companies made possible by the Government regulation of services and charges, the problems of the classification of railway traffic and of making railroad rates would be far more difficult than they now are. While it would not be impossible to classify ocean freight and to adjust canal charges with reference to classes and special commodities, the difficulties encountered would be so great as to overcome any theoretical advantages that might result from making the cargo rather than the vessel the basis of canal charges.

(*b*) The calculation of the tonnage of the cargo composing the lading of any particular vessel would have to be made from the ship's manifest, which, in the case of a vessel carrying several thousand tons of general freight, may contain many hundred entries, each entry ordinarily representing an individual shipment of some particular commodity. Over many ocean

routes the freight taken by the carrier is billed at carrier's option as weight or measurement cargo; and oftentimes the charges are by article rather than by weight or measurement. Over some ocean routes freight is taken by weight and the calculation of the tonnage of different classes of freight and of special commodities would not require much time and labor; but, as regards most freight handled upon the ocean, the calculation involved in determining the tonnage of the several classes and of the special, or "ex-class," commodities included in a ship's cargo would be expensive and time consuming. This tonnage calculation to determine the tolls payable would have to be made either before the ship cleared from its port of departure, or would have to be made while the vessel was en route between the port of clearance and the Panama Canal. A ship's personnel does not include a clerical force, and it is probable that the practice would be to detain the ship at the port of clearance until the tonnage upon which tolls are to be paid could be calculated in the office of the company or of the agents controlling the vessel's movements. As is well known, the ship's manifest, in its present form, is the last paper taken aboard the vessel, and in order not to delay a vessel's clearance it is customary for the steamship company's office force to work overtime for one or more days in order to have the ship's manifest ready as soon as possible after the vessel's cargo has been put aboard. To make a tonnage calculation for the purpose of preparing a statement of the tonnage of different classes of freight as a basis for canal charges would so delay vessel movements as seriously to burden ocean commerce.

(*c*) From the Government's point of view, cargo would be an undesirable basis for Panama tolls, because it would be practically impossible to detect and prevent fraud. A vessel presenting itself at the Panama Canal loaded possibly with hundreds of different articles could not be so inspected by the collectors of tolls as to check up the company's statement of cargo with the commodities listed in the ship's manifest or tonnage statement. It would be necessary for the canal officials to accept the sworn statement of the owners or master of the ship, and this would open the door to fraud. It is true that the Manchester Canal Co. derives most of its revenues from charges upon commodities, but this basis of charges is possible because the Manchester Canal includes the docks and warehouses at the ports of Manchester and other places along the waterway. In fact, the Manchester Canal Co. is both a canal and terminal company. Freight is loaded or discharged at Manchester and other canal ports, and the officials of the canal company can thus readily check the carriers' statements as to commodities loaded or discharged. In the case of such canals as the Kiel, the Suez, or the Panama, however, charges based upon commodities are administratively impracticable. The canals are merely transit routes where cargo is not transferred, loaded, or discharged. To prevent fraud in collecting tolls at transit canals, it is necessary to base the charges upon the ship rather than upon its cargo.

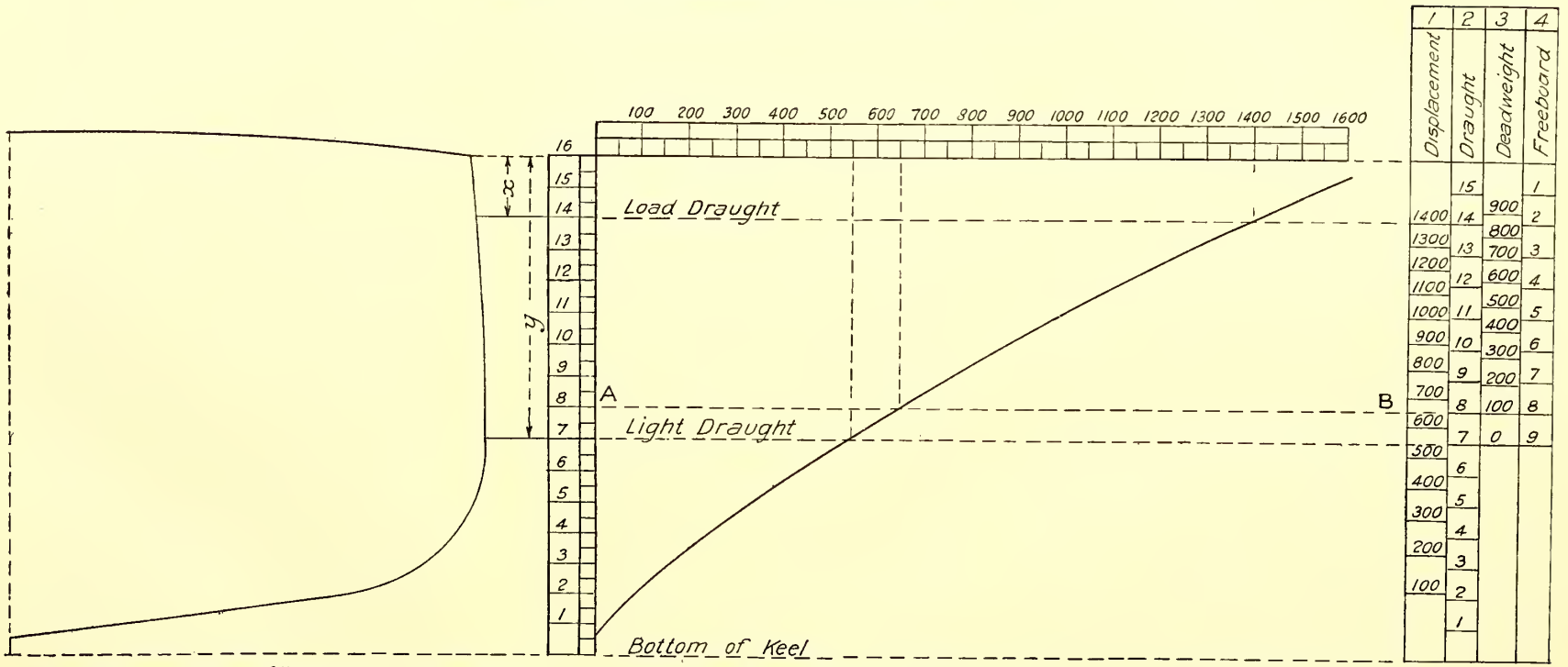
DISPLACEMENT TONNAGE.

Before discussing dead-weight tonnage, which is applied to the weight of cargo and fuel which vessels can carry, it will be best to explain displacement tonnage. The displacement ton is a unit applied to vessels and not to cargo, but in order to ascertain the dead-weight tonnage a vessel can carry it is first necessary to determine the vessel's displacement tonnage.

The displacement tonnage of a vessel is its weight in tons of 2,240 pounds avoirdupois, and is equal to the weight of water displaced by the vessel when afloat. Unless the term is qualified, the displacement tonnage of a vessel is the weight of the ship with its crew and supplies on board, but without fuel, passengers, or cargo. This is a vessel's displacement "light." The weight of water displaced by a vessel when loaded to its "deep-load line" is its displacement "loaded." The difference between the displacement tonnage of a vessel when "light" and when loaded to its "deep-load line" is its dead-weight tonnage, which is the maximum weight of fuel, cargo, and passengers that a vessel can carry.

A cubic foot of sea water weighs 64 pounds, or one-thirty fifth of an English long ton of 2,240 pounds avoirdupois. Thus the contents in cubic feet of that part of the vessel's hull

FIG. 27. DISPLACEMENT CURVE AND SCALE.



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by Thomas Walton, Naval Architect.

x = minimum freeboard_2'0" y = freeboard light_9'0"

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that is below the water line divided by 35 equal the vessel's displacement tonnage. If a ship were box-shaped—that is, if it were a parallelepiped—the product of its three dimensions in feet, its length, breadth, and its depth below the water line, divided by 35 would be the displacement tonnage; but, as vessel hulls are not parallelepipedons, the cubical contents of the hull of a ship have to be calculated by means of special mathematical rules, such as Simpson's rules or the trapezoidal rules.[1]

The ratio of the actual contents of the submerged portion of a ship's hull to the contents of a parallelepiped having length, breadth, and depth corresponding to the length, breadth, and draft of the ship is the vessel's "block coefficient" or its "coefficient of fineness." A full-shaped, slow freight steamer has a "block coefficient" of about 0.8—i. e., the submerged portion of the hull has a volume equal to 0.8 of the volume of a parallelepiped with equal dimensions. The "block coefficient" or "coefficient of fineness" of the average freight steamer varies from 0.7 to 0.75, while the coefficient of a combination freight and passenger steamer is about 0.65; that of a fast passenger steamer is about 0.6, while racing yachts may have a coefficient as low as 0.4. When the "coefficient of fineness" of a vessel is known, its displacement tonnage is determined by multiplying its length, breadth, and draft by its "coefficient of fineness" and dividing the product by 35.

In commercial practice it is desirable to know a vessel's displacement tonnage at any given draft between its "light" and "loaded" lines, for the reason that the difference between the displacement of a vessel "light" and the tonnage of its actual displacement indicates the weight of what the ship contains other than a crew and supplies. The displacement tonnage or weight of any particular ship at any given draft is shown by the vessel's "displacement curve" and scale. Figure 27 reproduces a typical displacement curve.

Figure 27 presents the displacement scale for a small vessel which draws but 7 feet of water when light, its displacement "light" being 550 tons. The vessel may load to a maximum draft of 14 feet, at which draft its displacement is 1,400 tons. The deadweight capacity of the ship is thus 850 tons. It may be noted in passing that the ship is permitted to be loaded, so that it has but 2 feet of freeboard, the freeboard being the distance between the level of the upper deck and the "deep-load line." Vessels engaged in the oversea trade would not be permitted to have such a small freeboard.

The figure also gives the ship's displacement curve. The curve is drawn as follows:

At the left the draft of the vessel and its freeboard are given in a perpendicular scale, which may be assumed to have been drawn to a scale of 1 inch to 1 foot. From the top of this vertical scale, a horizontal scale is so constructed that 1 inch equals 100 tons of displacement. By drawing horizontal lines through the points indicating the draft of the vessel at different drafts from zero to 14 feet and by drawing vertical lines through the points in the horizontal scale corresponding to the number of tons of displacement at various drafts from zero to 14 feet, and by drawing a curve through the points of the intersection of the horizontal and vertical lines, the curve of the ship's displacement is located. With this displacement curve known, the displacement of the vessel at any given point in its draft can be read off from the displacement scale.

ADVANTAGES AND DISADVANTAGES OF DISPLACEMENT TONNAGE AS A BASIS OF PANAMA TOLLS.

If displacement were made the basis of Panama tolls the charges might be placed either upon the vessel's displacement tonnage when loaded to the deep-load line, or upon its displacement tonnage at its actual draft, when applying at the canal for passage through the waterway. If the displacement of the vessel at its actual draft when passing through the canal were made the basis of the tolls, the charges would be levied upon the weight of the ship plus the weight of the cargo, passengers, and fuel it might have on board. The tolls would thus vary with the lading of the ship.

[1] Mathematical rules for the calculation of the contents of the hulls of ships are explained, among other places, in Chapter X of the book Know Your Own Ship, by Thomas Walton, London, 1909.

Displacement tonnage would have the following advantages as a basis for canal charges:

1. It would be easy to determine the tonnage upon which tolls were to be paid. The vessel's displacement scale states its displacement tonnage at any draft up to the deep-load line, which represents the vessel's maximum draft. The displacement scale would indicate the number of tons upon which the vessel applying for passage through the canal would have to pay tolls.

2. Tolls based upon the displacement of a vessel at its actual draft would vary with the ship's lading, and vessels without cargo or with a light load would pay less than the ship would pay when fully laden. In the case of low-powered cargo steamers, the weight of a vessel when "light" might be half or less than half the weight of the vessel when fully loaded, and the amount of tolls payable by such ships would be largely affected by the extent to which the vessel's cargo capacity was occupied with freight. On the contrary, high-powered passenger steamers have relatively small capacity for carrying cargo. So much machinery and fuel are required to secure high speed that the weight of the vessel "light" will probably be at least three-fourths of its weight when loaded. In the case of fast passenger steamers, there is comparatively little difference in the weight of the vessel when its passenger and freight accommodations are unoccupied and when they are filled. Such steamers, however, constitute a relatively small share of the tonnage of the world's deep-sea marine. For most ships, tolls based upon the tonnage of actual displacement would vary materially with the lading of the vessels.

3. An advantage of minor importance which displacement tonnage would have as a basis for tolls would be that merchant vessels and warships would pay charges upon the same kind of tonnage. Displacement is the only logical basis for tolls upon warships, and if merchant vessels do not pay canal levies upon displacement, the charges must be levied upon two different bases. While the inconvenience resulting from this would be relatively slight, it obviously would be better to have a single rather than a dual basis for canal charges.

The disadvantages resulting from the adoption of displacement as a basis for canal charges upon vessels of commerce outweigh the advantages, and may be briefly stated as follows:

1. Unless actual displacement were made the basis of canal charges, every vessel would be obliged to have marked upon its hull by official action of the appropriate authority its light line and its deep-load line, because the location of these lines would affect the amount of tolls payable. Freight ships under the British flag have the plimsoll mark placed upon the hull, indicating the draft to which the rules of the British Board of Trade and Lloyd's Association permit the vessel to be loaded. Passenger ships which carry comparatively little cargo, and which usually have several decks above the main deck, always have much more freeboard than the minimum requirements of the law, and thus there is no occasion for them to have a Plimsoll mark or a load line upon their hulls. If, however, the maximum load displacement were made the basis of canal charges, it would be necessary for passenger ships to have their load line officially determined, although the action taken in locating this load line would have to follow rules largely artificial in character.

Quite as much difficulty would be encountered in establishing officially any vessel's light draft, for the reason that the vessel's light line locates the ship's draft when equipped for a voyage with fittings, crew, and supplies. Vessels have their light line established without fuel on board, but an increasing number of vessels now use oil instead of coal for fuel and the oil thus used is often carried in tanks which, in the case of coal-burning steamers, would probably be used for water ballast. An oil-burning steamer when light may have less water ballast than a coal-burning steamer. The draft of a vessel without cargo or passengers would not be the same at all times or for all voyages. Thus the establishment of any vessel's light line would necessarily result from the application of arbitrary rules difficult to formulate and more difficult to apply.

2. If the actual displacement tonnage of a vessel at the time of its application for passage through the canal is made the basis of tolls, shipmasters may seek to lessen the vessel's draft temporarily by reducing the amount of water ballast to a minimum limit as the entrance to the canal is approached, in order that the vessel may thereby have less draft and be required to pay less tolls. When the vessel passes from the canal to the sea, the ballast tanks could

again readily be filled, and the ship's necessary ballast at sea could in this manner be easily replaced. It might also be possible for coal companies or even steamship companies to establish stations a slight distance from each entrance to the canal for the purpose of enabling vessels to replenish their bunkers or tanks after having passed through the canal and having paid the tolls. By entering the canal with a minimum amount of coal in the bunkers, and by coaling just after departing from the canal, a vessel would avoid the payment of tolls upon the weight of fuel it would normally carry.

3. The chief and conclusive reasons for basing tolls neither upon the actual displacement nor upon the deep-load line displacement of vessels are that such tolls would be unfair as between different types of ships, and would violate the fundamental principle of giving main consideration to earning capacity in levying canal charges. Tolls upon the weight or displacement of ships would be unfair as between different types of vessels, because fast passenger steamers have maximum weight in machinery, fittings, and fuel as compared with the weight of paying load, while slow cargo steamers have a maximum capacity for freight as compared with the weight of, and space occupied by, machinery, fittings, and fuel. In the case of the passenger steamer, the paying load is relatively light as compared with the nonpaying weight or "tare," while the freight steamer has an earning load heavy in relation to "tare." Otherwise stated, the fast ship of "fine" lines has a large displacement and small dead-weight capacity, while the ship with "full" lines has large carrying space in relation to light displacement. It is manifest that injustice as among different types of ships must result from taxing them upon the basis of their weight. In order to make tolls equitable for different classes of ships, it is necessary to base the charges primarily upon either what the ship is carrying or upon its earning capacity.

One method of levying tolls upon what the ship is carrying is to make "dead-weight" tonnage the basis of the charges; and, in order to determine whether that would be a desirable basis for Panama tolls, it is necessary to explain briefly what is meant by "dead-weight" tonnage and what would result from making it the basis of dues payable for the use of the canal.

DEAD-WEIGHT TONNAGE.

A vessel's dead-weight tonnage is the difference between the weight or displacement of the vessel when "light" and when loaded to its maximum authorized draft. It is the number of tons avoirdupois that the ship can carry of fuel, cargo, and passengers; it is the vessel's dead-weight capability, its carrying power.

The term dead-weight is also applied in commercial practice, to some extent, to the weight of coal and cargo actually aboard a ship at a given time. In this sense the dead-weight tonnage of a ship at any particular draft is the difference between its displacement "light" and its displacement at its actual draft.

Would it be wise to levy tolls either upon a ship's maximum dead-weight tonnage or upon the dead-weight of the fuel and lading actually aboard a vessel at the time of application for passage through the canal? As an argument in favor of tolls upon maximum dead-weight tonnage, it is urged that charges based upon the ship's carrying power are placed upon the weight from which the owners of the ship may derive traffic revenues. This argument is strengthened by the fact that the rates charged for the use of chartered vessels—i. e., charter rates—are upon dead-weight tonnage and that, inasmuch as a large share of ocean freight is transported in chartered vessels, the commercial world is accustomed to charges based upon dead-weight tonnage.

The advantages to be derived from making maximum dead-weight tonnage the basis of canal tolls are, however, more than offset by the objections to making that tonnage the unit of canal charges:

1. Freight ships, especially those employed in the transportation of bulk cargoes, would be heavily taxed, because of their large carrying power, while passenger steamers having comparatively little dead-weight capability would be but lightly burdened with canal tolls. Unless the rates of toll were different for different types of ships, there would be relative injustice as among different classes of vessels.

2. Even as between freight ships carrying different kinds of cargo the charges would be inequitable. The tolls payable would be largest for vessels loaded with the heaviest, and thus ordinarily the cheapest, commodities. Minerals, nitrate, lumber, grain, and other bulk commodities have large weight in comparison with value, and the canal tolls would fall most heavily upon the classes of commodities that ought to be most favored by the tolls. If cargo were made the basis of tolls, articles which are shipped as package freight ought to be charged tolls not upon their weight but upon their measurement tonnage—40 cubic feet, instead of 2,240 pounds, being considered a ton. This would probably not be practicable, but unless it were done the discrimination against heavy bulk cargoes would be unjust to the shippers of "dead weight freight." Carriers, moreover, would find tolls upon weight of cargo less desirable than charges upon space occupied by freight.

Would it be advisable to base Panama Canal tolls upon the actual weight carried by vessels using the canal? It would seem offhand that tolls upon the actual weight borne by the vessel would be on a proper and desirable basis. Ocean carriers would thus be called upon to pay charges for the use of the canal varying with the amounts transported through the waterway. The tolls would not be placed upon the vessel, but upon what is in the ship, and would be made to vary with the weight of the vessel's burden. Moreover, the tonnage upon which tolls were payable could theoretically be obtained without difficulty. It would be necessary only to read off from the vessel's displacement or dead-weight scale the difference between the ship's "light" displacement and its actual displacement at the time of passing through the canal.

As a matter of fact, however, the objections to tolls based upon the actual weight carried by vessels are stronger than the merits of such a system of charges. There are the same practical and equitable reasons against making actual dead-weight carried the basis of canal charges as there are against the maximum dead-weight tonnage as a basis for tolls. There would be the same difficulty encountered in deciding what should be considered the "light" draft of a vessel and thus what should be taken to be its "light" displacement. Likewise there would be the same inequity of charges as among different types of ships and as between similar ships carrying different kinds of cargo.

"BLOCK DISPLACEMENT."

A variation from the method of levying tolls upon a vessel's actual displacement at the time of passage through the canal would be to levy the charges upon the vessel's so-called "block displacement" or upon the cubical contents obtained by multiplying the length of a vessel's load water line by the vessel's breadth at the water line by its draft at any particular time. It would be the displacement of a parallelopipedon circumscribing the vessel, or of a block with dimensions equal to the length, beam, and draft of a vessel at the time of passage through the canal. The term "block displacement" is not generally used in tonnage literature, nor is the tonnage obtained by calculating the "block displacement" at present utilized for any purpose.[1]

"Block displacement" has never been adopted as a basis for canal tolls, dock, or other port dues, or tonnage taxes, nor has it ever been used as the basis for registering ships. Yet the idea of making "block displacement" the basis of shipping charges is a very old one. It was proposed in France as a possible basis for dock charges by the French naval architect Bouguer as early as 1746.[2] It was not adopted as the basis for dock charges, and Bouguer did not propose it as a possible basis for registering vessels or for any other purpose.

The tonnage determined by calculating the "block displacement" was also proposed to the Royal Commission on Tonnage of 1881, and was considered by that commission together with other possible bases for dock charges.[3] The majority of that commission rejected all tonnage bases, except net tonnage; one member of the commission favored dead-weight tonnage,

[1] This system was proposed as the basis for canal tolls, and the term "block displacement" was coined by Capt. C. A. McAllister, Engineer in Chief of the United States Revenue-Cutter Service. Hearings before House Committee on Interstate and Foreign Commerce, Jan. 15, 1912, p. 436.

[2] See White's Manual of Naval Architecture (5th Ed.), pp. 51 and 71–72.

[3] See Appendix XVIII.

and another displacement tonnage; but the "block displacement" idea was unanimously rejected.

Until suggested as a basis for Panama tolls, "block displacement" had been considered only as a tonnage upon which to impose dock charges. The tonnage obtained by multiplying a vessel's length by its breadth and draft would roughly indicate the water space occupied by a ship when in a dock, hence the suggestion that the space so occupied would be a fair basis for dock charges. Obviously, the "block displacement" of vessels of different types has little relation to their earning capacity. As is stated by the British naval architect, Sir W. H. White, the proposal that "block displacement" should be made the basis of shipping charges, "proceeds upon the assumption that dock and harbor dues should be paid on service rendered, and not on the earning powers of ships; and this assumption, as has been shown, is not generally admitted. * * * In view of the full discussion of the subject in 1881, and the recommendations of the Royal Commission, as well as the continuous extensions of international obligations, it is obvious that the Moorsom system [1] is now more thoroughly established than ever, and that no change seems probable, except as regards improvement in details." [2]

The advantages of "block displacement" as a basis for canal tolls would be those stated above in connection with actual displacement, with the additional advantage of greater simplicity. The tonnage or measurement officials of the Panama Canal could easily measure the length, breadth, and draft of a vessel applying for transit through the Canal, and there would be no necessity to consult the displacement curves and scales or other documents carried by the vessel.

"Block displacement" would have the same objections that actual displacement has as a basis for Panama charges, with the additional objection that block displacement is not the measure of anything actually in existence. Vessels are not block shaped; their coefficients of fineness vary from 0.4 to 0.9. "Block displacement" would discriminate most unfairly against vessels with fine lines, the discrimination increasing with the extent to which a vessel varied from the shape of the blunt freight steamer and the barge.

Tolls levied upon "block displacement" would violate the principle of basing canal charges upon the earning capacity of vessels. As will be explained in Chapters V and VII, net tonnage, accurately determined, represents the actual earning capacity of each vessel. If earning capacity is the proper basis upon which to levy Panama tolls, the charges can not be imposed upon "block displacement."

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[1] The Moorsom system of determining the tonnage of vessels is described in the following chapter.

[2] Manual of Naval Architecture, p. 72.

CHAPTER IV

GROSS TONNAGE AND ITS MEASUREMENT.

CHAPTER IV.

GROSS TONNAGE AND ITS MEASUREMENT.

Gross and net tonnage are terms applied to vessels and not to commodities. One hundred cubic feet of space is a vessel ton, and the gross tonnage of a vessel is the number of tons of 100 cubic feet within the ship's closed-in spaces.

The cubical contents of the closed-in spaces within any particular vessel would seem to be a fixed quantity definitely determinable, and would supposedly be the same whatever the flag of the ship or in whatever country the vessel is registered; but the several national rules for the measurement of vessels define closed-in spaces differently, and these rules vary as to what spaces shall be exempted from measurement, and thus from gross tonnage. Moreover, the Suez Canal Co.'s measurement rules are different from nearly all the national rules.

The present rules or methods followed in measuring vessels to determine their gross tonnage originated with Mr. George Moorsom, of England, and were first embodied in law in the British tonnage act of 1854. The Moorsom rules for the measurement of vessels have since then been adopted by practically all countries of the world and are now everywhere followed, although, as will presently be pointed out, the practice of the several nations of the world as to the exemption and measurement of spaces within vessels is far from uniform.

Prior to 1854 vessels were measured by brief rules which produced only approximately correct results. Those in force in England were established by the "new measurement" law of 1836. The need for improvement in the rules having become evident, the commissioners of the admiralty, at the request of the Board of Trade, appointed a committee in 1849 to recommend changes in the rules. The following year this committee recommended that the contents of vessels should no longer be determined by internal, but by external, measurement. Mr. Moorsom was honorary secretary of this commission, but did not approve of its recommendation. When it became evident that the report of 1850 was not to be accepted, Mr. Moorsom formulated the measurement rules which now bear his name. These rules were approved by the Board of Trade and made law by act of Parliament.

Mr. Moorsom worked out an exact mathematical method or formula for determining the cubical contents of vessels, and the ships then registered under the British flag were measured by these rules. It was found that the cubical contents of the entire British merchant marine was 363,412,456 cubic feet. At that time the total registered tonnage of the fleet was 3,700,000. The ratio of the number of cubic feet of contents to the number of tons register was 98.22 to 1. It was the desire of the British Government to make as little change as possible in the registered tonnage, and it was accordingly suggested by Mr. Moorsom that in order to simplify calculations 100 cubic feet instead of 98.22 should be considered a gross ton. This suggestion was adopted.

Mr. Moorsom's recommendations regarding measurement rules and tonnage were embodied in Rules 1, 2, and 3 of the tonnage act of 1854. These rules, as now in force, are printed in full in Appendix III to this volume. Rule 1 prescribes a method for measuring empty vessels, Rule 2 states how laden vessels shall be measured, and Rule 3 prescribes the rules to be followed in measuring the space occupied by the engine and machinery of steamships. In their present form the rules differ only in minor respects from those originally formulated by Mr. Moorsom.

The first country to follow England in the adoption of the Moorsom system of measuring spaces and the Moorsom ton was the United States, which embodied them without change in the act of 1864. The Suez Canal Co.'s measurement rules were formulated by the International Tonnage Commission which met at Constantinople in 1873. These rules provided that the gross tonnage of vessels shall be determined by the Moorsom system and be expressed in

Moorsom tons. Thus, by the action of the International Tonnage Commission and by the laws of the United States and other countries, a vessel ton is everywhere 100 cubic feet, and the contents of vessels are determined by the Moorsom system of measurement. The rules, however, concerning the spaces that shall be included in gross tonnage vary with different countries, and the regulations of the Suez Canal Co. are different from nearly all the national rules.

Dissimilarity in the several measurement codes is due to the fact that some include spaces which are exempted by other rules. Thus the same ship would not have the same measured contents and would not have the same gross tonnage by British, American, and Suez rules. It is obvious that if gross tonnage were made the basis of Panama tolls it would not be possible to accept the gross register tonnage of vessels as stated in their national registry certificates, because ships of the same size having different gross register tonnage would not be treated "on terms of entire equality, so that there shall be no discrimination * * * in respect of the conditions or charges of traffic." The Hay-Pauncefote treaty would be violated if Panama tolls were collected in accordance with the gross tonnage of vessels as stated in the ship's papers.

In discussing the measurement of vessels to determine their gross and net tonnage it is necessary to keep in mind the distinction between "exemption" and "deduction" from measurement. Measurement rules stipulate what spaces shall be measured to determine a vessel's gross tonnage and what part of the vessel shall be exempted from measurement, while the rules governing the determination of net tonnage specify which of the spaces that have been measured shall be deducted. Net tonnage, as will be explained later in detail, is ascertained by deducting from the contents of the spaces that have been measured and included in gross tonnage the contents of such spaces as the rules designate shall not be included within the net tonnage of the vessel. The gross tonnage of a vessel depends upon the spaces exempted from and upon the spaces included within the measurement, while a ship's net tonnage is affected by the specifications of the rules as to the exemption of spaces from measurement and as to the deductions to be made from the spaces included within the gross tonnage. The rules regarding the measurement and exemption of vessels control the gross tonnage and indirectly determine the net tonnage of vessels.

In order to collect the same Panama tolls from vessels of like size and capacity, it is necessary that the gross tonnage of the vessels shall be determined by the same rules. Although the tolls are levied upon net tonnage, it is none the less necessary that the measurement rules should stipulate what shall be included in gross tonnage as well as what shall be deducted therefrom in the calculation of net tonnage.

Spaces of a surprising number are differently treated by the several rules for the measurement of vessels. As will be brought out later in this chapter, the leading national rules and those of the Suez Canal Co. have different provisions as to the exemption or measurement, in whole or in part, (1) of the light and air and funnel spaces above the engine and boiler room; (2) of spaces within such superstructures as the forecastle, poop, bridge, wheelhouses, donkey-engine house, the house or rooms in which charts and navigation instruments are kept, galleys, bakeries, cookhouses, toilets, bathrooms, crew quarters, lockers for anchor chain, and lookout houses; and (3) spaces under the uppermost full-length deck usually called the shelter deck. The location of these superstructures and spaces upon typical ships is indicated in the longitudinal profiles presented in Chapter II.

The variations in the rules governing gross tonnage and in the regulations or instructions issued for the guidance of measurers in applying rules result mainly from the different interpretations that have been put by law and practice upon the terms "closed-in" and "open" spaces. The gross-measurement laws of practically all countries are based upon the British Merchant Shipping Act of 1854, which provided that—

> If there is a break, a poop, or any other permanent closed-in space on the upper deck available for cargo or stores, or for the berthing or accommodation of passengers or crew, the tonnage of such space shall be ascertained * * * and shall be added to its tonnage.

The meaning of this law hinged upon the interpretation given to the words "permanent closed-in space." It was the practice of the Board of Trade after the enactment of the law of 1854 to measure, and thus to include in the gross tonnage, the closed-in spaces and superstructures above the uppermost deck and also all spaces under that deck. Within a few years, however, it came to be the practice of shipbuilders to leave one or more openings, other than the regular hatchways, in the uppermost deck in the manner described above in Chapter II. These "tonnage" openings, while not constructed as hatchways, might be covered over with planks and tarpaulins at sea during rough weather. The owners of the vessels with these "tonnage" hatches or openings claimed exemption from measurement of the space between the uppermost deck and the deck below it, which at that time was the main deck of the vessel. The Board of Trade refused to exempt the space between what came to be called the shelter deck and the deck below it; but the Clyde Steam Navigation Co. of Glasgow, in 1875, in the case of the steamer *Bear*, secured a decision from the House of Lords, which required the Board of Trade to treat as "open," and thus to be exempted from measurement, the space under the uppermost continuous deck through which there were one or more openings other than the regular hatchways.

Efforts to secure an amendment to the act of 1854 that would so define closed-in and open spaces as to enable the Board of Trade to enforce the law as it had been enforced before the decision of the House of Lords in the *Bear* case, proved ineffective; and in consequence the British rules still exempt from measurement large spaces actually used for the stowage of cargo. The present requirements of the Board of Trade regarding the exemption of spaces are as follows:

The attention of the surveyors is called to the following points relating to the exemption from measurement of spaces situated above the upper deck:

The minimum width and height of the permanent openings in the bulkheads is fixed at 3 feet and 4 feet, respectively, and if coamings are fitted thereto their height must not exceed 2 feet.

This rule also applies when exemption from measurement is claimed for the space between the upper and shelter decks, when such spaces are subdivided by one or more transverse bulkheads.

A single opening on one side of a bulkhead is not considered sufficient to entitle the space thus partitioned off to exemption, unless, in addition to this, there are a number of freeing ports and scuppers fitted on each side of the space claimed. In such cases the owner's application for exemption and also a sketch of the space drawn to scale must be forwarded to the principal surveyor for tonnage for examination, and exemption must not be allowed without the Board's approval. In shelter deck cases, when the permanent deck opening is situated aft, there must be at least two openings in all the transverse bulkheads in the 'tween deck on the fore side of it to entitle the space to exemption.

As regards the dimensions of the permanent middle line opening in the shelter deck, the length must not be less than 4 feet clear opening, and the width must at least be equal to that of the after cargo hatch upon the same deck. The distance between the after edge of the deck opening and the aft side of the sternpost must not be less than one-twentieth the registered length of the vessel, or if placed forward the fore side must not be less than one-fifth the length of the vessel from the stem.

The builders of vessels engaged in the transportation of miscellaneous cargoes are careful so to construct the ships as to bring them within the technical requirements of the Board of Trade as to open spaces, although the larger part of the technically open spaces is actually used for stowing cargo.

The Suez rules concerning both gross and net tonnage were formulated by the International Tonnage Commission, which met at Constantinople in the autumn of 1873. The rules adopted by that commission concerning the spaces to be included in gross tonnage were and are as follows:

The gross tonnage or total capacity of ships comprises the exact measurement of all spaces (without any exception) below the upper deck, as well as of all permanently covered and closed-in spaces on that deck.

By permanently covered and closed-in spaces on the upper deck are to be understood all those which are separated off by decks or coverings, or fixed partitions, and therefore represent an increase of capacity which might be used for the stowage of merchandise, or for the berthing and accommodation of the passengers or of the officers and crew. Thus any one or more openings, either in the deck or coverings, or in the partitions, or a break in the deck, or the absence of a portion of the partition, will not prevent such spaces being comprised in the gross tonnage, if they can be easily closed in after admeasurement, and thus better fitted for the transport of goods and passengers.

But the spaces under awning decks without other connections with the body of the ship than the props necessary for supporting them, which are not spaces, "separated off," and are permanently exposed to the weather and the sea,

will not be comprised in the gross tonnage, although they may serve to shelter the ship's crew, the deck passengers, and even merchandise known as "deck loads."

"Deck loads" are not comprised in the measurement.

Closed spaces for the use or possible use of passengers will not be deducted from the gross tonnage.

The above rules of the International Tonnage Commission were based upon the British Merchant Shipping Act of 1854, but closed-in and open spaces were carefully defined. The *Bear* case, which was decided by the House of Lords in 1875, had arisen in 1872, and thus it was understood in 1873 to be necessary carefully to stipulate what should be considered open spaces and what closed ones in the measurement of vessels. In defining a space as closed-in when it represented "an increase of capacity which might be used for the stowage of merchandise or for the berthing and accommodation of the passengers or the officers and crew," the International Tonnage Commission minimized the possibility of evading the measurement rules with a view to reducing tonnage. The International Tonnage Commission by this definition of a closed-in space established definitely the principle that gross tonnage should include the entire closed-in capacity of the ship. The adoption of this policy, it may be added, received the support of the representatives of Great Britain on the International Tonnage Commission.

Minor changes were subsequently made by the Suez Canal Co. in the definition as given above of closed-in spaces, but the changes were found to improve neither the definition nor the measurement rules framed in accordance with the definition. For this reason the company in 1904 issued a memorandum stating precisely how its rules should be applied to the measurement of superstructures. The interpretation given the rules by the 1904 memorandum corresponds closely with the definition given to closed-in spaces by the International Tonnage Commission in 1873. This memorandum, with illustrations, is reproduced as Appendix XIII to this volume.

In 1902, to prevent the exemption from measurement of spaces used for the carrying of cargo, the Suez Canal Co. provided in its rules that—

Should a vessel at any time transit with merchandise of any kind, or bunker coal or stores of any description, in any portion whatever of any exempted space, the whole of that space is added to the net tonnage and can nevermore be exempted from measurement.

This stipulation was included in the memorandum of 1904, and it has simplified the enforcement of the Suez Canal Co.'s general principle, that the gross tonnage of a vessel shall include all closed-in spaces and that its net tonnage shall represent its actual earning capacity.

The United States in 1864 adopted a law, effective in 1865, for the measurement of vessels, which incorporated the provisions of the British Merchant Shipping Act of 1854, and the stipulations of the law as regards open and closed spaces have been interpreted by the United States authorities as were the corresponding provisions of the British Merchant Shipping Act by the Board of Trade prior to the decision of the House of Lords in the *Bear* case, in 1875; that is to say, any space that is either actually closed-in or capable of being closed-in against the sea is included in the ship's measurement. There was one important and unwise exception made made to this principle by an act of February 28, 1865, which provided that—

No part of any ship or vessel shall * * * be measured or registered for tonnage that is used for cabins or staterooms, and constructed entirely above the first deck which is not a deck to the hull.

This clause exempts from measurement the space in all tiers of superstructures above the first tier, if, as is customary, the spaces in the tiers of superstructures above the first tier are used for cabins or staterooms. With the growth in the size of passenger steamers and in the number of decks above the uppermost full-length deck, our laws have come to exclude from the tonnage of the larger passenger vessels a considerable share of their actual closed-in capacity. The amendment of 1865 seems to have been enacted for the purpose of favoring the steamers on our seaboard, lakes, and western rivers. Some of these steamboats had cabins or staterooms above the promenade deck, whereas ocean steamers at that time had their passenger accommodations below the upper deck. The law of 1865 came, in course of time, to be applied to ocean steamers and is still in force, although it has no justification.

The customs regulations of the United States, which interpret the laws regarding the measurement of vessels, define closed-in spaces as follows:

By "closed-in spaces" is to be understood spaces which are sheltered from the action of the sea and weather, even though openings be left in the inclosure. Measuring officers will exercise due vigilance that the intent of the law in this respect is not evaded. It should be borne in mind, however, that no closed-in spaces above the upper deck to the hull are to be admeasured unless available for cargo or stores or the berthing or accommodation of passengers or crew. The engine room, pilot house, galley, windlass house, and the like are, when so situated and used, exempt.

Whether for the purpose of measurement a deck is to be regarded as an upper deck or as the shelter to an upper deck is to be determined in each instance both by the character and structural conditions of the erection and by the purpose to which the between-deck is devoted. Differences in construction are so numerous that no definition or rule on this subject has been formulated. If the deck is a continuous deck, fastened down and water-tight, sealing up the cylinder formed between the two decks and making it a fit place for the stowage of cargo, like a hold, the deck is to be treated as an upper deck, and the space between it and the deck below is to be measured. If, however, the cylinder is open to the shipment of seas, and the space is not reasonably fit for the carrying of dry cargo, but is used only for cargo generally classed as deck cargo, such as cattle, horses, chemicals, oil in barrels, etc., then, usually, the deck is to be regarded as a shelter deck, and the space as "sheltered space above the upper deck which is under cover and open to the weather, that is, not inclosed," and not to be included in the recorded tonnage.

Specific as are the foregoing instructions, the admeasurers at the several ports of the United States are obliged to exercise their judgment as to what shall be considered open and what closed spaces. The practice of our admeasurers is not uniform at all ports. The surveyor of the port of New York, where most vessels are measured for tonnage taxes and where many of our ships are measured for registry and enrollment, reports the following regulations to be in force at that port:

1. *Closed-in spaces above the upper deck.*—If there be a break, poop, bridge, forecastle, deck house, hatchway, or any other permanent closed-in space above the upper deck available for cargo or stores, or for the berthing or accommodation of passengers or crew, the tonnage of that space shall be ascertained and added to the gross tonnage.

2. *Closed-in spaces defined.*—By closed-in spaces is to be understood spaces which are sheltered from the action of the sea and weather, even though openings be left in the inclosure. Forecastles, bridges, poops, or any other permanent erection with one or more openings in the sides or ends fitted with doors or other permanently attached means of closing them should be measured and included in the gross tonnage.

3. *Bulkhead openings.*—When an opening in the bulkhead of a deck erection is closed either by a hinged door, or by a portable plate which is secured in place by nut and screw bolts so as to be water-tight, the opening may be regarded as completely closed.

4. *Openings in front of bridge house or poop.*—When there is an opening or openings in the bulkhead at the front of a bridge house or poop closed by hinged doors or by shifting boards when fitted into channel bars, which extend the full height of the opening, the space may be regarded as closed.

5. *Openings in after end of bridge house or forecastle.*—When there are openings in the bulkhead at the after end of a bridge house or forecastle, closed by portable plates secured in place by nut and screw bolts or closed by shifting boards, when fitted into channel bars which extend the full height of the openings, the space may be regarded as completely closed.

6. *Open spaces.*—Spaces under awning decks without other connection with the body of the ship than the stanchions necessary for supporting them, which are not spaces separated off and are permanently exposed to the weather and the sea, will not be comprised in the gross tonnage.

7. *Exempted spaces.*—It should be borne in mind, however, that no closed-in spaces above the upper deck to the hull are to be admeasured, unless available for cargo or stores or the berthing or accommodation of passengers or crew. The engine room, pilot house, galley, windlass house, and the like are, when so situated and used, exempt.

8. *Exemption of cabins on decks above upper deck.*—No part of any vessel will be admeasured or registered for tonnage that is used for cabins or staterooms and constructed entirely above the first deck which is not a deck to the hull.

9. *A deck to the hull defined.*—Any deck is a deck to the hull which has a direct bearing upon the frame timbers, even though lighter than other decks in the same vessel and though only a portion of the timbers extend to such deck. In iron vessels an upper deck supported by stanchions of wood or iron bolted to the angle irons or to the iron plating of the vessel is to be taken as a deck to the hull.

The foregoing definitions given to open and closed spaces by the measurement authorities of Great Britain and the United States and by the regulations of the Suez Canal Co. show clearly the possibility of large variations in the gross tonnage of vessels of the same size and design. In order fully to explain the differences in the practice of measuring vessels to determine their gross tonnage, the British, Suez, German, and American rules are analyzed in turn and compared.

It will be seen that the rules and practice of these three countries and the Suez company, while agreeing as to the inclusion within gross tonnage of the principal spaces used or usable for the accommodation of passengers and crew (other than the spaces under the shelter deck which are usually exempted from measurement in Great Britain and Germany), differ as to the inclusion within, or exemption from, gross tonnage of various minor spaces which taken together may appreciably affect the gross, and consequently the net, tonnage of the vessels measured by the several rules.

GREAT BRITAIN'S GROSS TONNAGE RULES.

The analysis of the measurement rules may best begin with those of Great Britain, because the British Merchant Shipping Act of 1854, in which the Moorsom measuring system was first incorporated, has been made the basis of the measurement laws and rules of the other countries. The British practice as to the measurement of vessels has largely influenced the rules adopted by other countries, because the British marine comprises nearly or quite half the shipping engaged in international trade. Formerly the percentage was even higher than it is at the present time.

The British Merchant Shipping Act of 1854 has been somewhat modified by the laws of 1867, 1876, 1889, 1894, 1906, and 1907. The present rules of the Board of Trade governing the measurement of vessels are in accordance with the Merchant Shipping Acts of 1894, 1906, and 1907; and, of course, are so drafted as to conform to the decisions rendered by the House of Lords and the British Courts in 1875 and later, defining what constitutes open spaces within the meaning of the Merchant Shipping Act of 1854. The measurement rules now in force in Great Britain include the following spaces within gross tonnage:

1. The space between the upper deck and the floor of the hold, with the exception of certain minor exempted spaces included within hatchways, companionways, domes and skylights and spaces between ribs and floor beams in the case of certain vessels. The exact spaces exempted are enumerated below.

2. Gross tonnage under the British rules includes the spaces within any "break, poop, or any permanent closed-in space on the upper deck available for cargo or stores or for the berthing or accommodation of passengers or crew." The meaning given to the words "permanent closed-in" by the British courts and consequently by the Board of Trade has been explained above. Whenever the poop, forecastle, or any superstructure is inclosed according to the requirements of the British rules, the space is measured and included within the gross tonnage. The space under a shelter deck is not included in the measurement, if the openings in the shelter deck and in the bulkheads subdividing the space between the shelter and upper decks fulfill the requirements of the regulations prescribed by the Board of Trade in accordance with the decision of the House of Lords in the *Bear* and other cases. If cargo is carried in spaces which have the openings stipulated by the rules and which are thus exempted from measurement, the actual space occupied by the cargo is measured. The space thus occupied by "deck cargo" is not added to the vessel's gross or net tonnage, but is added to the tonnage upon which light dues or other tonnage taxes are collected.

3. The space occupied by hatchways is measured and the part of this space in excess of one-half of 1 per cent of the vessel's gross tonnage exclusive of hatchways is added to the gross tonnage of a vessel.

The following spaces are exempted from measurement and are thus not included in the gross tonnage under the British rules:

1. Superstructures not permanently inclosed; that is, superstructures having the openings prescribed by the rules.

2. Spaces under the shelter deck, provided the shelter deck and the bulkheads subdividing the space between the shelter deck from the upper deck have the openings prescribed by the Board of Trade rules.

3. Any closed-in space or spaces solely appropriated to and fitted with machinery, and the wheelhouse for sheltering the man or men when at the wheel, if not larger than required for such purposes.

4. Any erection on the upper deck of vessels fitted for the shelter of deck passengers on short voyages. The exemption of this space from measurement, however, is admissible only by special directions from the Board of Trade. When claim is made by the vessel owner for exemption of these spaces, the surveyors must apply to the Board of Trade for instructions.

5. The cook house and bakeries, when fitted with ovens and used entirely for their designated purposes, and the condenser space, provided the cook house, bakeries, and condenser space are not larger than are required to shelter the cook when employed at his work and the engineer when engaged in condensing water for passengers and crew.

6. Toilets of reasonable size and number for officers and crew. In the case of passenger vessels, a toilet exempted from measurement is allowed for each 50 persons, but not more than 12 toilets are exempted.

7. The light and air and funnel spaces above the machinery compartments are exempted from measurement unless the owner of the vessel, for reasons that will be explained later, requests the inclusion of these spaces within the measurement.

8. Of the space included within hatchways, one-half of 1 per cent of the gross tonnage of the vessel exclusive of hatchways is omitted from the gross tonnage.

9. The spaces within the double bottom used for water ballast are exempted from measurement. When such spaces are used for or are available for the carriage of cargo, stores, or fuel they are measured and included in the gross tonnage.

10. The spaces between the frames or ribs of a vessel and between the floor beams are not included in the measurement. The breadth of the vessel is its width between the inner edges of its frames or between the inner faces of the inner side plating. The depth of a vessel is measured upward from the upper side of the floor timber or beam "at the inside of the limber strake"; that is, next to the keelson at the center line of the vessel.

11. Companionways are exempted from measurement excepting such portions of them as are used for smoking rooms. Ladders and stairways in exempted spaces are excluded from measurement.

12. Domes and skylights are exempted from measurement.

The "certificate of survey" issued by the surveyors of the Board of Trade to vessels measured under the British rules is presented, reduced in size, in Form 1. It summarizes the spaces included within gross tonnage. The "tonnage formula," Form 2, used for calculating the ship's tonnage under the Merchant Shipping Acts of 1894 to 1907 indicates in detail the spaces that are measured. This "tonnage formula" also contains other entries that will later be considered in the discussion of net tonnage.

Form 1.—British Tonnage Certificate.

[Certificate of survey.]

Name of ship.	Port of intended registry.	Official number, if there has been any former registry.

Whether British or foreign built.	Whether a sailing or steamship; and if a steamship, how propelled.	Where built.	When built.	Name and address of builders.

		Feet.	Tenths.
Number of decks	Length from fore part of stem under the bowsprit to the aft side of the head of the sternpost		
Number of masts	Length at quarter of depth from top of weather deck at side amidships to bottom of keel		
Rigged	Main breadth to outside of plank		
Stern	Depth in hold from tonnage deck to ceiling at midships		
Build	Depth in hold from upper deck to ceiling at midships in the case of three decks and upwards		
Galleries	Depth from top of beam amidships to top of keel		
Head	Depth from top of deck at side amidships to bottom of keel		
Framework and description of vessel	Round of beam		
Number of bulkheads	Length of engine room (if any)		
Number of water ballast tanks and their capacity in tons			

Particulars of Displacement.

Total to quarter the depth from weather deck at side amidships to bottom of keel	tons.	Ditto per inch immersion at same depth	tons.

Particulars of Engines, etc. (if any).

No. of engines.	Description.	Whether British or foreign made.	When made.	Name and address of makers.	No. of and diameter of cylinders.	Length of stroke.	N. H. P. I. H. P. speed of ship.
	Engines.		Engines.	Engines.			
	Boilers. Number. Iron or steel. Pressure when loaded.		Boilers.	Boilers.			

Particulars of Tonnage.

Gross tonnage.	No. of tons.	Deduction allowed.	No. of tons.
Under tonnage deck		On account of space required for propelling power	
Closed-in spaces above the tonnage deck, if any: Space or spaces bet. decks. Poop. Forecastle. Roundhouse. Other closed-in spaces, if any, as follows:		On account of spaces occupied by seamen or apprentices, and appropriated to their use, and kept free from goods or stores of every kind, not being the personal property of the crew. These spaces are the following, viz:	
Spaces for machinery, and light and air, under sec. 78 (2) of the Merchant Shipping Act, 1894, if required. Gross tonnage. Deductions as per contra.		Deductions under sec. 79 of the Merchant Shipping Act, 1894, as follows: Cubic meters.	
Registered tonnage		Total	

Note.—The only spaces above the upper deck not included in the cubical contents forming the ship's registered tonnage are.....

I, the undersigned....., having surveyed the above-named ship, hereby certify that the above particulars are true, and that her name is marked on each of her bows, and her name and the port of registry are properly marked on a conspicuous part of her stern, a scale of feet marked on each side of her stem and of her stern post, and lines permanently and conspicuously marked on each side amidships indicating the position of each deck which is above water, in manner directed by the Merchant Shipping Act, 1894.

Dated at ——, this —— day of ——, 18—.

—— ——
Surveyor.

REGISTRY FORM No. 1 and Surveys 59. Prescribed by H. M. Customs

[Seal of Com. of Council for Trade.]

With the Consent of the Board of Trade.

Tonnage formula. *Class 5, for lengths above 225 feet, to be used for calculating the*

Surveys 58.

[SEAL.]

(Issued by the Board of Trade.)

Builder's name and yard number.	Intended service, whether pas towing, fishing, or pleasu

Name of ship.	Official number and port of registry.	Whether new or re-measured.	Whether sail, paddle, or screw.	Whe wood, iron,

	Area 1.	Area 2.	Area 3.	Area 4.	Area 5.	Area 6.	Area 7.	Area 8.	Area 9.	Area 1
Depths.....	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Com. int. bet. bths.....										

No. of bths.	Multi-pliers.	Bths. Ft.	Prod-ucts.	Bths. Ft.	Bths. Ft.	Bths. Ft.	Bths. Ft.	Bths. Ft.	Bths. Ft.	Bths. Ft.	Bths. Ft.	Bths. Ft.
1	1											
2	4											
3	2											
4	4											
5	2											
6	4											
7	1											

⅓ com. int. bet. bths.....

Between.....decks.

Mean length.....ft.

Com. int. bet. bths.....

No. of bths.	Multi-pliers.	Bths. Ft.	Prod-ucts. Ft.
1	1		
2	4		
3	2		
4	4		
5	2		
6	4		
7	2		
8	4		
9	2		
10	4		
11	2		
12	4		
13	1		

⅓ com. int. bet. bths.....

Height.....

Between.....decks.

Mean length.....ft.

Com. int. bet. bths.....

No. of bths.	Multi-pliers.	Bths. Ft.	Prod-ucts. Ft.
1	1		
2	4		
3	2		
4	4		
5	2		
6	4		
7	2		
8	4		
9	2		
10	4		
11	2		
12	4		
13	1		

⅓ com. int. bet. bths.....

Height.....

Forecastle.

Mean length.....ft.

Com. int. bet. bths.....

No. of bths.	Multi-pliers.	Bths. Ft.	Prod-ucts. Ft.
1	1		
2	4		
3	1		

⅓ com. int. bet. bths.....

Height.....

Break.

Mean length ...

Com. int. bet. bths.....

No. of bths.	Multi-pliers.	Bths Ft.
1	1	
2	4	
3	1	

⅓ com. int. bet. bths.....

Height.....

Bridge.

Mean length.....ft.

Com. int. bet. bths.....

No. of bths.	Multi-pliers.	Bths. Ft.	Prod-ucts. Ft.
1	1		
2	4		
3	1		

⅓ com. int. bet. hths.....

Height.....

Poop.

Mean length...

Com. int. bet. bths.....

No. of bths.	Multi-pliers.	Bth Ft
1	1	
2	4	
3	1	

⅓ com. int. bet. hths.....

Height.....

Round of beam.....

Type of ship, and if cellular or macintyre double bottom.

In the case of steam vessels the engine

Position of engine room....	Engi Boile

Carried forward.....

Tonnage formula. *Class 5, for lengths above 225 feet, to be used for calculating the ship's tonnage under the Merchant Shipping Acts, 1894 to 1907.*

Surveys 58.	Builder's name and yard number.	Intended service, whether passenger, cargo, towing, fishing, or pleasure yacht.	Name and address of owner.	Place and year of build.

[SEAL.]

(Issued by the Board of Trade.)

Name of ship.	Official number and port of registry.	Whether new or re-measured.	Whether sail, paddle, or screw.	Whether of wood, composite, iron, or steel.	Whether for Suez or British.

Length on tonnage deck. } Feet.

Where measured.....

Date of measurement.....

Tons.

Cubic content and register tonnage.

Area 1.	Area 2.	Area 3.	Area 4.	Area 5.	Area 6.	Area 7.	Area 8.	Area 9.	Area 10.	Area 11.	Area 12.	Area 13.
Depths..... *Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Com. int. bet. bths.....												

No. of bths.	Multipliers.	Bths. Ft.	Products.	Bths. Ft.	Bths. Ft.	Bths. Ft.	Bths. Ft.	Bths. Ft.	Bths. Ft.	Bths. Ft.	Bths. Ft.	Bths. Ft.	Bths. Ft.
1	1												
2	4												
3	2												
4	4												
5	2												
6	4												
7	1												

½ com. int. bet. bths.....

No. of area.	Multipliers.	Areas brght. up.	Products.
1	1		
2	4		
3	2		
4	4		
5	2		
6	4		
7	2		
8	4		
9	2		
10	4		
11	2		
12	4		
13	1		

½ com. int. bet. areas.

Under deck.

Between....decks.

Between....decks.

Forecastle.

Bridge.

Break.

Poop.

Roundhouses.

Side houses.

Chart house.

Light and air spaces.

____ Excess of hatchways. Cubic meters.

Gross tonnage.

____ Allowance for propelling power.....

____ Allowance for crew space.....

____ Deduction under section 79.

____ Register tonnage.....

Between.....decks.

Mean length.....ft.

Com. int. bet. bths.....

No. of bths.	Multipliers.	Bths. Ft.	Products. Ft.
1	1		
2	4		
3	2		
4	4		
5	2		
6	4		
7	2		
8	4		
9	2		
10	4		
11	2		
12	4		
13	1		

½ com. int. bet. bths.....

Height.....

Between.....decks.

Mean length.....ft.

Com. int. bet. bths.....

No. of bths.	Multipliers.	Bths. Ft.	Products. Ft.
1	1		
2	4		
3	2		
4	4		
5	2		
6	4		
7	2		
8	4		
9	2		
10	4		
11	2		
12	4		
13	1		

½ com. int. bet. bths.....

Height.....

Forecastle.

Mean length.....ft.

Com. int. bet. bths.....

No. of bths.	Multipliers.	Bths. Ft.	Products. Ft.
1	1		
2	4		
3	1		

½ com. int. bet. bths.....

Height.....

Break.

Mean length.....ft.

Com. int. bet. bths.....

No. of bths.	Multipliers.	Bths. Ft.	Products. Ft.
1	1		
2	4		
3	1		

½ com. int. bet. bths.....

Height.....

Bridge.

Mean length.....ft.

Com. int. bet. bths.....

No. of bths.	Multipliers.	Bths. Ft.	Products. Ft.
1	1		
2	4		
3	1		

½ com. int. bet. bths.....

Height.....

Poop.

Mean length.....ft.

Com. int. bet. bths.....

No. of bths.	Multipliers.	Bths. Ft.	Products. Ft.
1	1		
2	4		
3	1		

½ com. int. bet. bths.....

Height.....

Houses (naming them)..... *Tons.*

Carried forward.....

Houses, brought forward..... *Tons.*

Carried forward.....

Houses, brought forward..... *Tons.*

Hatchways..... *Tons.*

Round of beam.....

Type of ship, and if cellular or macintyre double bottom.....

Signature of surveyor.

Signature of examiner.

Identification dimensions.

In the case of steam vessels the engine-room measurements and the calculations for the allowance for propelling power are to be given in detail below.

Length.	Breadth.	Depth.

Position of engine room....

Engine room bulkhead is.....feet (forward) (aft) of area .....
Boiler room bulkhead is.....feet (forward) (aft) of area.....

Tons.	*Tons.*	*Tons.*
	Brought forward.....	Brought forward.....
Carried forward.....	Carried forward.....	.....

Merchant Shipping Act, 1907.

	Tons.
Gross tonnage.....	
Deductions under section 79, viz:	
To	
1. Crew space.....	
2. Other deductions.....	
Remainder.....	
Multiplier for percentage.....	.55
Limit of allowance for propelling power.....	*Tons.*

Particulars of exempted spaces.....

.....

Identification dimensions.

-room measurements and the calculations for the allowance for propelling power are to be given in detail below.

Length.	Breadth.	Depth.

ne room bulkhead is.....feet (forward) (aft) of area .....
r room bulkhead is.....feet (forward) (aft) of area.....

Tons.		*Tons.*		*Tons.*	
	Brought forward.....		Brought forward.....		

Merchant Shipping Act, 1907.

	Tons.
Gross tonnage.....	
Deductions under section 79, viz:	
To-	
1. Crew space.....	
2. Other deductions.....	
Remainder.....	
Multiplier for percentage.....	.55
	Tons.
Limit of allowance for propelling power.....	

Particulars of exempted spaces.....

	Carried forward.....	.....	.....

back form 2.)

Suez Gross Tonnage Rules.[1]

The Suez Canal Co.'s rules for the measurement of vessels, as has been stated, were formulated by the International Tonnage Commission at Constantinople in 1873. That commission adopted the Moorsom system of measuring vessel spaces, and the rules of the commission state that there shall be included within the gross tonnage "all spaces, without any exception, below the upper deck," and "all permanently covered and closed-in spaces on that deck."

In measuring the superstructures upon or above the uppermost full-length deck, the rules as amended in 1904 provide for the exemption from measurement of portions of certain closed-in spaces which are considered as open under the rules of the country of the ship's registry. The provisions of the rules are as follows:

I. SHIPS WITH ONE TIER OF SUPERSTRUCTURES ONLY.

1. *Poop, bridge, forecastle.*—The following exemptions are allowed:

(*a*) Such length of the poop measured from the inside of the stern timber, at half height of the said poop, as shall be equal to one-tenth of the full length of the ship.

(*b*) The portion of the bridge in way of the air spaces of [spaces within and at the side of casings above] the engine and boiler spaces, it being understood that such air spaces are not considered to extend beyond the forward bulkhead of the stokehold and the after bulkhead of the main engine room. [See figures accompanying Appendix XIII.]

(*c*) Such length of the forecastle measured from the inside of the stem at half height of the said forecastle as shall be equal to one-eighth of the full length of the ship.

(*d*) In each of the above three cases of superstructures such portions in the walls of the ships as are in way of openings not provided with any means of closing and corresponding to one another.

2. *Poop and bridge combined, or forecastle and bridge combined.*—In each of these combined spaces the following exemptions are allowed:

(*a*) That length only which corresponds to the openings of the engine room and boiler spaces as specified in (*b*) above.

(*b*) Such portions as are in way of openings not provided with any means of closing and corresponding to one another.

3. *Shelter decks.*—In the case of shelter decks the following exemptions are allowed: The portions in way of openings in the side plating of the ship not provided with any means of closing and corresponding to one another. Such air spaces as are situated within the shelter deck must be measured into the engine-room space and deducted, together with 75 per cent of their volume.

II. SHIPS HAVING MORE THAN ONE TIER OF SUPERSTRUCTURES.

(*a*) The exemptions prescribed in paragraphs 1, 2, and 3 above are applicable in their entirety to the lower tier only.

(*b*) Tiers above the lower tier are only allowed the exemption of such portions as are in way of openings in the side plating of the ship not provided with any means of closing and corresponding to one another.

The foregoing rules stipulate that when a vessel has one tier of superstructures, including detached poop, bridge, and forecastle, there shall be exempted from measurement and gross tonnage, when the spaces are considered as closed-in by the Suez rules and as open by the rules of the country of the ship's registry: (*a*) The space included in the poop for a distance of one-tenth of the length of the ship measured from the inside of the stern timber; (*b*) the portion of the bridge or the combined poop and bridge within and at the side of, and for the length of, the casings surrounding the air spaces above the engine and boiler room; (*c*) the space included in the forecastle for a distance equal to one-eighth of the length of the ship measured from the inside of the stem; and (*d*) in the case of all three of these superstructures, the space between opposite permanent openings in the side walls of the ship.

[1] See Appendixes XII and XIII for the Suez Canal Co.'s rules for the measurement of vessels and for the "memorandum" concerning the application of the rules to the measurement of superstructures.

When the poop and bridge are united into a continuous structure, the space within the poop equal to one-tenth of the length of the ship is not exempted from measurement. Likewise, when the forecastle and bridge are combined there is no exemption of the space within the forecastle equal to one-eighth of the length of the ship; but that portion of the bridge taken up by the light and air space above the engine and boiler room is exempted from measurement, as are also spaces between permanent opposite openings in the side walls of the ship.

The memorandum issued by the Suez Maritime Canal Co. upon the application of its 1904 rules to the measurement of superstructures states that when the poop, bridge, and forecastle are united into one they constitute a shelter deck. In the case of the shelter deck thus formed, the only spaces exempted from measurement are "the portions in way of openings in the side plating of the ship not provided with any means of closing and corresponding to each other," and the rules further provide that "such air spaces as are situated within the shelter deck must be measured into the engine-room space and deducted together with 75 per cent of their volume."

When a vessel has two or more tiers of superstructures, the foregoing exemptions regarding the spaces within the poop, bridge, and forecastle, when separated from each other and when combined, apply in their entirety only to the first tier of superstructures above the upper full-length deck of the ship. As the rules above quoted state, the tiers above the lower tier are allowed the exemption of only such spaces as are between permanent opposite openings in the sides of the ship.

Steamers now in service may have numerous superstructures, such as roundhouses, side houses, galleys, cookhouses, bathrooms, wheel, chart and donkey-engine houses, and inclosures required for the working of the ship, for smoking rooms, and companion houses. All such spaces are measured and included in the vessel's gross tonnage. Hatches, also, as has been stated, are measured and their space in excess of one-half of 1 per cent of the gross tonnage of the vessel exclusive of hatchways is included in the ship's tonnage.

The definitions given to closed-in and open spaces by the rules of the Suez Canal Co. are stated on page 47. These definitions, formulated by the International Tonnage Commission upon the recommendation of the representatives of Great Britain, provide that all spaces capable of being so closed as to be usable "for the stowage of merchandise or for the berthing and accommodation of the passengers or of the officers and crew" shall be included in the measurement, and that openings in the deck or coverings of the spaces or in the partitions separating the spaces under the deck containing the openings shall not entitle spaces to exemption from measurement if the openings can be so closed, after the ship has been measured, as to make the spaces available for the transportation of goods or passengers. In order to make this rule effective and to avoid the attempts that had been made to exempt shelter-deck spaces from measurement,[1] the Suez Canal Co. in 1902 adopted the rule still in force that "should a vessel at any time transit with merchandise of any kind, or bunker coal, or stores of any description, in any portion whatever of any exempted space, the whole of that space is added to the net tonnage and can nevermore be exempted from measurement." The enforcement of this principle has resulted in including in the gross tonnage of the vessels measured under the Suez rules their usable or earning capacity. Moreover, the determination of what is an open or a closed space does not rest with the measurers of vessels but with the officials of the canal company charged with the duty of collecting tolls and hence with checking up the tonnage of vessels.

Briefly stated, the Suez rules as now enforced so measure the gross tonnage of vessels as to include in that tonnage the entire space (with the exception of designated exemptions enumerated below) under the tonnage deck and between the tonnage deck and the uppermost deck and the space (subject to the exemptions allowed some ships by the "memorandum" of 1904) in such superstructures as poop, forecastle, bridge, side and round houses, galleys, and bakeries. The term "permanent closed-in" is defined to mean spaces so fitted as to be capable of being so closed as to be used for the transportation of cargo, fuel, provisions, or passengers.

[1] For an historical account of the treatment of the measurement of superstructures by the Suez Canal Co. consult Appendix XI.

Form 3.—Suez Canal Tonnage Certificate.

[SEAL.]

(Issued by the

Name of ship.	Official number.	Port of registry.	Tonnage on certificate of registry.	
			Gross.	Net.

Form 3.—Suez Canal Tonnage Certificate.

[SEAL.] (Issued by the Board of Trade.)	Name of ship.	Official number.	Port of registry.	Tonnage on certificate of registry. Gross.	Net.

Details of Tonnage for the Above-named Ship When Passing Through the Suez Canal.

	Cubic meters.	Tons of 100 cubic feet each.
The spaces measured for gross tonnage in this ship comprise the following and no others, viz:		
1. Space under the tonnage deck		
2. Space or spaces between the tonnage deck and the uppermost deck		

3. Closed-in spaces under or in permanent constructions above the uppermost deck, viz:	Tons of 100 cubic feet.
Forecastle, &c.	
Bridge space	
Poop	
Break or breaks	
Turret	
Trunk	
Round houses ——ins ——tons ——tons ——ins ——tons ——tons ——tons.	
" " ——tons ——tons ——tons ——tons ——tons ——tons.	
Side houses ——tons ——tons ——tons ——ins ——tons ——ins ——tons.	
" " ——tons ——tons ——tons ——ins ——tons ——tons ——tons.	
Companion house, part of, used as smoking room, &c., L. ×B. ×H. = tons	
Galleys, cookhouses, water-closets, lavatories, and bathrooms	
Wheelhouses, chart house, house for donkey boiler, and other closed-in spaces used in working the ship	
Hatchways ——ins ——tons ——tons ——tons ——ins ——ins.	
" ——tons ——tons ——tons ——ions ——tons ——tons.	
" ——tons ——tons ——tons ——tons ——ins ——tons.	
Excess above one-half per cent of the gross innage	
Total of tonnage of closed-in spaces above the uppermost deck	
Gross register tonnage	

Note.—For particulars of spaces not included in the measurement for gross tonnage, see over.

Deductions from Gross Tonnage.

	Tons of 100 cubic feet.
1. Berthing accommodation of crew:[1]	
Seamen ——tons; fireman ——ins; quartermasters ——ins; ——ins; ——tons.	
——tons; ——ins; ——tons; ——tons; ——tons.	
2. Berthing of officers:[2]	
Chief officer ——tons; 2nd officer ——ins; 3rd officer ——tons; ——tons; ——tons.	
——tons; ——tons; ——tons; ——tons; ——tons.	
Chief engineer ——tons; 2nd engineer ——ins; 3rd engineer ——tons; ——tons; ——tons.	
——ins; ——tons; ——tons; ——tons.	
Boatswain ——tons; carpenter ——tons; ——ions; ——tons.	

	L.	B.	D.	Tons.		L.	B.	D.	Tons.
Doctors' cabins[4]	×	×	=		Officers' mess room[5]	×	×	=	
Engineers' mess room[5]	×	×	=		Petty officers' mess room[5]	×	×	=	
Officers' bathroom[6]	×	×	=		Engineers' bathroom[6]	×	×	=	

3. Galleys, cookhouses, water-closets, and lavatories,[6] exclusively for the use of the officers and crew:

L.	B.	D.	Tons.	L.	B.	D.	Tons.	L.	B.	D.	Tons.	L.	B.	D.	Tons.
×	×	=		×	×	=		×	×	=		×	×	=	
×	×	=		×	×	=		×	×	=		×	×	=	
×	×	=		×	×	=		×	×	=		×	×	=	
×	×	=		×	×	=		×	×	=		×	×	=	

4. Closed-in spaces above the uppermost deck used in working the ship, as follows:

	L.	B.	D.	Tons.		L.	B.	D.	Tons.		L.	B.	D.	Tons.
Chart house[3]	×	×	=		Lookout house	×	×	=		Signal house	×	×	=	
Wheelhouse	×	×	=		Steam-steering house	×	×	=		Wireless telegraphy spaces[7]	×	×	=	
	×	×	=			×	×	=		Searchlight spaces[7]	×	×	=	

Total deduction in a sailing ship[8]

Net Register Tonnage (if a sailing ship)

Further deductions for propelling power in the case of steamers:	Tons of 100 cubic feet.
Either (1) applicable in ships with fixed bunkers—	
(*a*) Engine room as measured This includes water-tight shaft trunk and all spaces set apart for the working of the machinery and boilers	
viz.: under Tonnage Deck ——Tons. In 'tween decks ——Tons. In ——on the uppermost deck ——Tons	
(*b*) Permanent coal bunkers as measured	
Arts. 14 and 17 of Appendix B of the regulations.	
Total deduction for propelling power*	
Net Register Tonnage of Steamer by Actual Measurement	
Or (2) Danube rule—	
(*a*) Engine room as measured. This includes water-tight shaft trunk and all spaces set apart for the working of the machinery and boilers	
(*b*) In a screw steamer + 75 per cent of engine room as measured	
(*c*) In a paddle steamer + 50 per cent of engine room as measured	
Arts. 14 and 16 of Appendix B of the regulations.	
Total deduction for propelling power*	
Net Register Tonnage of Steamer by Danube rule	

*This deduction is not, except in the case of tugs, to exceed 50 per cent of the gross register tonnage of the ship.

This is to certify that the British ship above named has been remeasured, and that the tonnage ascertained as above is in accordance with the rules adopted by the International Tonnage Commission at Constantinople.

Given under my hand at the Board of Trade, this ——day of ——191 .

One of the Assistant Secretaries to the said Board.

[OVER.]

Full dimensions and innage of exempted and open spaces.

Length from inside the stem at half the height of the forecastle to the inside of the stern timber at half the height of the poop = ——feet.

One-eighth length = ——feet.
One-tenth length = ——feet.

Particulars of deck spaces.	Tons.	Particulars of exempted spaces.	Tons.

Notes referring to the particulars on page 1 of this certificate.

(1) Stewards, cooks in passenger steamers, and passengers' servants are not part of the crew for whom space is to be deducted.

(2) The accommodation for the captain, purser, clerk, &c., is not to be included in this deduction.

(3) When there is no separate chart room and the captain's accommodation comprises several rooms, one of which is used as the chart room, that room alone is deducted. In all cases it must be situated above the uppermost deck.

(4) The deduction of doctors' cabins is subject in the condition that they must be actually occupied by the doctors.

(5) The following spaces may be deducted: A mess room, if there is any, for the exclusive use of the officers; a second mess room, if there is any, for the exclusive use of the engineers; and a third mess room, if there is any, for the exclusive use of the petty officers.
No deduction is allowed for the officers' mess room in ships having passenger accommodation, which are not also provided with a passengers' mess room.

(6) All spaces fitted as bathrooms or lavatories for the exclusive use of the ship's officers, engineers, and crew may be deducted, with the exception of such of the said bathrooms as are available for passengers when no bathroom for their exclusive use is provided.

(7) All spaces specially provided for the sinrage of electric searchlights and wireless telegraphy appliances may be deducted on condition that they are situated on the upper deck.
N. B.—The deduction of the spaces mentioned above is subject in the condition that they are clearly and permanently marked so as to shew the purpose to which they are exclusively appropriated.

(8) This deduction is in no case to exceed 5 per cent of the entire gross innage of the ship, and so soon as any sinres or cargo are carried in or passengers are berthed or accommodated in any of the spaces deducted the whole deduction ceases.

The spaces exempted from measurement under the Suez rules as amended in 1904 are the following:

1. Spaces in the double bottom. Also, the spaces between the frames and the floor beams are not measured.

2. That part of a bridge or of a combined bridge and poop that is in way of the light and air and framed-in funnel spaces above the engine and boiler rooms. As is shown by figure 18 accompanying Appendix XIII, the present Suez rules exempt the bridge space, in the first or lowest tier of superstructures from side to side of the ship for the length of the framed-in funnel spaces and the light and air casings, but not beyond the limits of the forward and aft bulkheads of the engine and boiler room. In order to be exempted this bridge space must be closed-in under the Suez rules and open under the rules of the country of the vessel's registry. In the superstructures above the first tier, the spaces framed-in around the funnels and the space within the light and air casings, being open, are not measured; but the bridge spaces alongside the framed-in funnels and the light and air casings are measured. The space *within* the entire light and air casing and framed-in funnels above the first tier of erections, if any, upon the upper deck is exempt unless the shipowner desires to forego some other specified exemptions and to have some of the exempted light and air and funnel spaces measured into the engine and boiler room for deduction under the Danube rule.[1]

3. The space within the poop for one-tenth of the length of the ship measured from the inner side of the sternpost and the space within the forecastle for one-eighth of the length of the ship measured from the inside of the stem, provided the poop and forecastle are not connected with the bridge. This exemption is granted only when the spaces are open under the national rules of the country of the ship's registry, but closed-in under the Suez rules.

4. All superstructures not permanently inclosed, under the Suez rules. Of the spaces under the "shelter" deck, only those between permanent opposite openings in the side plating of the ship are exempted.

5. Companionways except such portions of them as may be used as a smoking room, and the ladders and stairways located in exempted spaces.

6. The space occupied by hatchways up to one-half of 1 per cent of the ship's gross tonnage exclusive of the hatchways.

7. The space occupied by domes and skylights.

8. The space occupied by cargo carried upon the open deck, i. e., by deck loads, is not measured.

The tonnage certificate that is issued by the British Board of Trade to vessels measured in accordance with the Suez rules is reproduced in Form 3. The certificate states what spaces are included in gross tonnage and what spaces are deducted therefrom to determine the net tonnage.

Vessels are measured for the Suez Canal Co. by the appropriate authorities in the several commercial nations. In Great Britain the Moorsom system is applied to the measured spaces strictly in accordance with the general measurement rules of the Suez Canal Co. In Germany and France, however, the Moorsom system is applied in the measurement of vessels for Suez Canal certificates, the same as the Moorsom system is applied in measuring vessels for French or German registry. The results are not quite the same in the several countries, but the differences are so slight that the Suez Canal Co. accepts the result without correction. This is done in order to simplify the administrative work.

The history of the difficulties encountered by the Suez Canal Co. in maintaining uniform practice as to the inclusion of spaces for, or their exemption from, measurement is recited in Appendix XI. Since 1904 the company has made no change in its rules affecting the gross tonnage other than to make the concession that superstructures erected, and used solely, for the safety of navigation may be exempted from measurement, unless such spaces are included in the vessel's tonnage under the national rules of the country in which the ship is registered.

[1] For explanation of the application of the Danube rule see pp. 74. Also consult Appendix XIII.

GERMANY'S GROSS MEASUREMENT RULES.

The rules in force in Germany for the measurement of vessels were established by the imperial statute of January 5, 1872. Previous to that time different German States had dissimilar rules, and none of them had the Moorsom system of measurement that was adopted by the imperial law of 1872. The provisions of the act of 1872 have been modified from time to time. The law as it now stands stipulates that gross tonnage shall "include the spaces located under the uppermost deck of the ship and the permanent superstructures on or above the uppermost deck." Otherwise stated the German law provides for the measurement and inclusion in gross tonnage of: (1) The spaces under the tonnage deck and between the tonnage and upper decks; (2) "the space occupied by all covered and inclosed superstructures permanently erected on or above the first deck which are inclosed by substantial bulkheads and coverings suitable for the stowage of freight or merchandise or for quarters or other accommodations of the crew and passengers;" and (3) hatches in excess of one-half of 1 per cent of the gross tonnage.

The German rules exempt from measurement the same spaces that are excluded from measurement in England. The provisions of the law as to the exemption of spaces in superstructures are as follows:

1. All covered and inclosed spaces which are used exclusively for the operation of the auxiliary machinery, and also the pilot house for the protection of the men at the steering wheel, provided these spaces are not larger than necessary for the purpose specified.

2. Any structure necessary on short voyages for the protection of deck passengers against storm and waves, if the measurement board is authorized by the Bureau of Registry to exempt it.

3. The kitchen (galley) and the place for the distilling apparatus, provided they are not larger than actually necessary for the preparing of meals, at the same time affording sufficient shelter to the machinist while distilling water for the passengers and the crew.

4. Toilets for the officers and crew of the ship, provided they do not exceed the proper number and size.

5. On ships designed for the transportation of passengers, a toilet for every 50 persons can be omitted from the calculation provided the total number exempted does not exceed twelve.

In addition to the above spaces, the German rules exempt from measurement:

6. Double-bottom water ballast tanks and spaces between the frames and floor beams.

7. Companionways located between decks; ladders and stairways in exempted spaces; domes and skylights.

8. Hatches up to one-half of 1 per cent of the gross tonnage exclusive of hatchways.

9. Light and air spaces over the engine and boiler rooms are exempted, above the upper deck, unless this space needs to be added to the cubical contents of the engine and boiler rooms to bring the power space up to that percentage of the gross tonnage of the vessel that will permit the application of the Board of Trade percentage rule controlling deductions for power spaces.

The interpretation which the German measurement authorities now give to open and inclosed spaces is practically the same as the definition given those terms by the Board of Trade in Great Britain.

The technical directions issued by the German Government (see Appendix VII) to its surveyors of ships as to the measurement of closed-in and open spaces under the shelter deck and in superstructures are more detailed and specific than the instructions given by the Board of Trade to British surveyors; but the German rules seem to be applied in such a way as to produce practically the same results as are secured by the British surveyors in applying their rules. In one particular the German rules are more lenient toward shipping than are the British rules. Deck cargoes are not measured in Germany as they are in Great Britain. In neither country are deck loads included in the registered tonnage; but in Great Britain the space occupied by deck cargo is measured and added to the tonnage upon which light dues and other port charges are levied.

At the end of Appendix VI reprints will be found of the three forms of German measurement certificates—the certificates issued for decked vessels, for open vessels, and for vessels measured

by the abbreviated method. Each certificate states what spaces are included in gross tonnage and what spaces shall be deducted therefrom in the calculation of net tonnage. The certificate issued to decked vessels is the one most frequently used. It is printed here as form 4.

FORM 4.—GERMAN TONNAGE CERTIFICATE.

FOR DECKED VESSELS.

GERMAN EMPIRE.

Kind of vessel.	Name of vessel.	Distinctive signal.	Nationality home port.

SHIP'S MEASUREMENT CERTIFICATE.

DESCRIPTION OF VESSEL.

Builder	Character of upper deck	Shape of bow
Year built		Shape of stern
Place built	Number of water-tight transverse bulkheads	Number of funnels
Material	below and above the tonnage deck	Number of masts
Kind of construction	Number of water ballast tanks with hatches	Rigging
Number of decks	Planking	

STANDARD DIMENSIONS.

Meters.

1. Length of vessel from the rear face of the prowpost to the rear face of sternpost on the uppermost permanent deck (in vessels with patent rudder, measure to middle of rudder post).....
2. Greatest beam of vessel between outer surfaces of planking or of the wales.....
3. Depth of hold from lower surface of the upper permanent deck to the upper surface of lower transoms next to the keelson, or to upper surface of the inner iron double bottom, if there is one, at middle of length as found in 1.....
4. Greatest length of engine room, including any permanent coal bunkers, between the limiting bulkheads extending from side to side.....

RESULTS OF MEASUREMENT.

Gross tonnage.	Cubic meters.	Deductions.	Cubic meters.
1. Space under tonnage deck		I. On account of space required for propelling power	
2. Space between tonnage deck and the one above		II. Crew, navigation, etc.:	
3. Space between first and second decks above tonnage deck		1. Spaces for sailors, firemen, deck officers, cooks, stewards, etc.	
4. Quarter-deck cabin or poop		2. Spaces for officers, engineers, etc	
5. Forecastle		3. Wheelhouses, chart house, etc	
6. Space under bridge deck		4. Sail room	
7. Break or breaks		5. Ship's stores	
8. Other spaces		6. Spaces for water ballast	
9. Excess of hatchways		III. Spaces for the master	
Gross tonnage		Total deductions	

	Cubic meters.	Registered tons.		Cubic meters.	Registered tons.
Gross tonnage			Final result of measurement:		
Deductions			Gross tonnage		
Net tonnage			Net tonnage		

In accordance with the ship measurement ordinance of March 1, 1895, this measurement certificate is made out from the measurement completed on ..... day of ....., 19.., by the measurement board at ..... by the complete method.

.....

.....

NOTE.—The following constructions on or above the upper deck are considered open spaces, and are, therefore, not included in the above measurements of gross and net tonnage:

AMERICAN GROSS TONNAGE RULES.

In 1864, by the law approved May 6, the United States adopted the Moorsom system of measuring vessels to determine their gross tonnage. The measurement system then adopted by the United States was practically the same as Great Britain had established by the Merchant Shipping Act of 1854. The act of 1864, however, made provision only for the determination of gross tonnage, which until 1882 was the tonnage upon which tonnage taxes and other ship charges were levied at American ports.

The spaces included in measurement and the spaces exempted therefrom by the law of 1864, as interpreted by the measurement authorities in the United States, were the same as the spaces measured and exempted under the rules of the British Board of Trade prior to the modification of those rules made necessary by the decision of the House of Lords in the *Bear* case in 1875. Large spaces which the Board of Trade rules consider open and thus not subject to measurement are properly included in measurement and gross tonnage under the American regulations.

The act of May 6, 1864, was amended by a law passed February 28, 1865, which provided that—

> No part of any ship or vessel shall be measured or registered for tonnage that is used for cabins or staterooms and constructed entirely above the first deck, which is not a deck to the hull.

The Customs Regulations of the United States (see Appendix II, p. —, to this volume) state that this amendment—

> Was designed merely to exclude cabins and staterooms above the "promenade" deck of the steamers of the seacoast and lakes, or above a "boiler" deck as used on the western rivers. It does not have the effect to exempt from admeasurement any closed-in place, even if so situated, if used for cargo or stores.

Although the amendment of February 28, 1865, was enacted with reference to coastwise, lake, and river steamers, it was also applied to ocean steamers. Thus in the case of modern passenger steamers which have several tiers of passenger accommodations above the upper deck only the first tier is measured. This rule regarding upper tiers of superstructures prevails in no other country and is without justification.

The measurement rules of the United States provide in general that the gross tonnage of a vessel shall include "the entire internal cubical capacity" ascertained by the Moorsom system in a manner prescribed by statute. Specifically stated, the spaces included in the measurement, and thus in the gross tonnage, are the following:

1. The entire space under the tonnage deck and between the tonnage and upper decks.
2. The space occupied by hatchways in excess of one-half of 1 per cent of the vessel's gross tonnage exclusive of the tonnage of hatchways.
3. Any "break, poop, or any other permanently closed-in space on the upper deck available for cargo or stores or for the berthing or accommodation of passengers or crew." What constitutes a closed-in space is defined in the manner explained above. Moreover, the law of 1865 provides that the passenger accommodations in the tiers of superstructures over the first tier above the upper deck shall be exempted from measurement.

The gross tonnage rules of the United States exempt the following spaces from measurement:

1. Double bottom water ballast spaces not available for cargo, stores, or fuel and the spaces between the frames and the floor beams.
2. Spaces under the shelter deck and in the poop, forecastle, and bridge, when not permanently closed in.
3. Passenger accommodations in tiers of superstructures over the first tier above the upper deck.
4. Hatchways up to one-half of 1 per cent of the vessel's gross tonnage.
5. Galleys, bakeries, toilets, and bathhouses above decks.
6. Spaces above decks occupied by the ship's machinery or for the working of the vessel.
7. Light and air and funnel space over the engine and boiler room to the extent that such space is above the upper deck or the "shelter deck" when that is taken as the uppermost full-length deck, except when special request is made by the shipowner to have the space measured.
8. Domes and skylights, companionways (except portion used as smoking room), and ladders and stairways located in exempted spaces.
9. Open spaces occupied by deck loads are not measured under the American rules.

The inclusion in or exemption from measurement of particular superstructures depends, under the American rules, upon the judgment of the individuals who measure the ship as to whether the spaces are closed-in or open. The practice of admeasurers has not been entirely uniform. The definition of closed-in spaces, as given in the customs regulations and as formulated by the surveyor of the port of New York, were stated above. In general, the American treatment of the shelter-deck spaces is the same as that given such spaces by the Suez Canal Co. The American regulations, however, do not provide that when a shelter deck has once been used for cargo it shall always thereafter be considered a closed-in space; but if an American admeasurer finds that dry cargo is carried in any space he takes that fact as evidence that the space is closed-in. The Suez and American practice in this regard, as has been explained, differs from that of Great Britain and Germany, where the character of the openings and the devices for closing the openings, rather than the use made of the spaces, determine whether the admeasurers shall consider the spaces as open or closed-in.

Form 5 reproduces the American certificate of admeasurement issued under the authority of the Bureau of Navigation, in the Department of Commerce. The certificate indicates in general what spaces are included in measurement, and thus in gross tonnage, and states what spaces shall be deducted therefrom in calculating net tonnage.

FORM 5.—AMERICAN TONNAGE CERTIFICATE.

Cat. No. 1414.

Always present this certificate when entering at an American port.

Certificate of admeasurement of ——— vessel.
(Insert "American" or "Foreign.")

(Sec. 4149, Revised Statutes, and Art. 84, Customs Regulations of 1908.)

DEPARTMENT OF COMMERCE,
BUREAU OF NAVIGATION,

OFFICE OF ——— ——— OF CUSTOMS,
PORT OF ——— ———,
——— ———, *19*—.

I certify that an admeasurement has been made of the ——— ——— called the ——— ——— of ——— ———, built in the year 19—, at ——— ——— of ——— ———, that she has a ——— ——— head, a ——— ——— stern, ——— ——— decks, ——— ——— masts, and that her register length is ——— ——— $\frac{}{10}$ feet, her register breadth is ——— ——— $\frac{}{10}$ feet, her register depth is ——— ——— $\frac{}{10}$ feet, her height under spar deck is ——— ——— $\frac{}{10}$ feet and that her tonnage is as follows:

	Tons.	100ths.
Capacity under tonnage deck		
Capacity between decks, above tonnage deck		
Capacity of inclosures on the upper deck, viz (describe each inclosure)		
Gross tonnage		
Deductions under Sec. 4153, Revised Statutes, as amended by act of Mar. 2, 1895. (To be made only as provided for by law and regulations.)		
Crew space ———; master's cabin ———,		
Steering gear (below deck), ———; anchor gear (below deck), ———; boatswain's stores, ———,		
Chart house, ———; donkey engine and boiler (below deck), ———		
Storage of sails, ———; propelling power (below deck or by permission of Commissioner of Navigation) ———		
Total deductions		
Net tonnage		

Net tonnage is carried on main beam, and name and port are marked as required by law.[1]

——— ———,
——— ——— *of Customs.*

I agree to the above description and admeasurement.[2]

——— ———.

(Indorsement on back:)
Cat. No. 1414. Department of Commerce. Bureau of Navigation. District of ——— ———. Port of ——— ———. ——— ———, 191-. ——— ——— of Customs.
Certificate of admeasurement of the ——— ———, called the ——— ——— of ——— ———.

[1] If a foreign vessel, this may be erased.
[2] To be signed by the master, owner, or other person who may attend the admeasurement for the vessel.

COMPARISON OF THE GROSS TONNAGE RULES OF GREAT BRITAIN, THE SUEZ CANAL CO., GERMANY, AND THE UNITED STATES.

The foregoing account of gross tonnage attempts to explain the leading characteristics of the measurement rules of Great Britain, the Suez Canal Co., Germany, and the United States. The spaces included within gross tonnage and those exempted from measurement are enumerated, and the different treatment given to above-deck spaces is explained. To facilitate comparison of these four codes of rules, their differences and similarities may well be set forth by textual and tabular enumeration. The provisions of the several rules regarding spaces included in measurement are as follows:

1. In each set of rules gross tonnage is assumed to include all parts of a vessel that are permanently inclosed. The capacity of such spaces is determined by Moorsom's measurement system applied with but slight variation by the several rules.

2. In each case the spaces under the tonnage deck and between the tonnage and upper decks are included in gross tonnage.

3. Hatchways in excess of one-half of 1 per cent of the gross tonnage, exclusive of hatchways, are included in the tonnage.

4. In theory closed-in spaces above the upper deck are included in the measurement and tonnage and open spaces are exempted. Measurement rules and practice, however, vary as regards these spaces. The treatment accorded superstructures and "shelter-deck" spaces in the measurement rules of Great Britain, the Suez Canal Co., Germany, and the United States are compared in detail below in Table I.

The provisions in the four sets of gross tonnage rules under consideration in regard to spaces exempted from measurement may be compared as follows:

1. Double-bottom spaces used for water ballast are exempted from measurement, unless (in the case of the national but not of the Suez Rules) they are available for cargo, stores, or fuel. The methods of measurement are such as to exempt spaces between the ship's frames and its floor beams.

2. The same below-deck spaces are included in all four codes of measurement rules.

3. The application of the Moorsom system of measurement varies slightly with the different rules, and the under deck tonnage of the same vessel might be slightly different when measured by different rules. The treatment accorded each of the several above-deck structures and the below-deck spaces is shown for each of the four sets of rules in Table I.

TABLE I.—*Measurement of gross tonnage under the measurement rules of Great Britain. the Suez Canal Co., Germany, and the United States.*

Portion of vessel.	United Kingdom.	Suez Canal.	Germany.	United States.
Forecastle	Measured if "closed-in" and available for cargo, passengers, crew, or stores; exempted if "open" or not available for cargo, passengers, crew, or stores.	Measured if "closed-in" under national and Suez rules; partly exempted if "open" under national rules, but closed-in under Suez rules. Suez definition of "closed-in" spaces stricter than in United Kingdom and Germany.	Same as United Kingdom.	Same as United Kingdom, but with stricter definition of "closed-in."
Poop or break	do	do	do	Do.
Bridge space	do	do	do	Do.
Side houses	do	Measured if "closed-in" under Suez rules.	do	Do.
Deck houses	do	do	do	Do.
Spaces for anchor gear, steering gear, and capstan.	Exempted if above decks; measured if below decks.	Measured	do	Same as United Kingdom.
Wheelhouse	Exempted	do	Exempted	Exempted.
Chart, lookout, and signal houses.	Measured	do	Measured	Measured.
Boatswains' stores	do	do	do	Do.

TABLE I.—*Measurement of gross tonnage under the measurement rules of Great Britain, the Suez Canal Co., Germany, and the United States*—Continued.

Portion of vessel.	United Kingdom.	Suez Canal.	Germany.	United States.
Donkey engine and boiler rooms.	Measured if below decks. Measured if above decks and connected with engine room; exempted if not so connected.	Measured	Same as United Kingdom.	Same as United Kingdom.
Hatchways	Exempted up to one-half per cent of gross tonnage; excess is measured.	Same as United Kingdom	do	Do.
Sail room of sailing vessel	Measured	Measured	Measured	Measured.
Galleys, cookhouses, condenser spaces, and bakeries.	Exempted if above decks; measured if below decks.	do	Same as United Kingdom.	Same as United Kingdom.
Skylights and domes	Exempted	Exempted	Exempted	Exempted.
Light and air spaces above engine room.	Owner given option for portion of space above upper deck.	Owner given option under Danube rule, but if measured he forfeits certain exemptions; if German rule is applied they are measured.	Same as United Kingdom.	Owner given option for entire space above upper deck.
Companion houses	Measured if used as smoking room or for other special purpose; otherwise exempted.	Same as United Kingdom	do	Same as United Kingdom.
Passageways	Measured when serving measured spaces.	do	do	Do.
Toilets, lavatories, and bathrooms.	Above decks 1 toilet for every 50 passengers, not exceeding a total of 12, and those used by the crew and officers are exempted. Those below decks are measured.	Measured	do	Do.
Crew and officers' quarters	Measured	do	Measured	Measured.
Superstructures above first deck that is not a deck to the hull.	Treated the same as the first tier of superstructures.	Measured if "closed-in" under the national and Suez rules; portions in way of side openings are exempted if "open" under the national rules, but "closed-in" under Suez rules.	Same as United Kingdom.	Cabins and staterooms are exempted.
Shelters for deck passengers on short voyages.	Exempted with consent of Board of Trade.	Exempted if "open"	Exempted with consent of Bureau of Registry.	Exempted with consent of Commissioner of Navigation.
"Shelter deck" spaces	Exempted if "open" according to court decision and Board of Trade instructions. Shelter decks are ordinarily exempted.	Measured if "closed-in" under national and Suez rules; portions in way of side openings are exempted if "open" under the national rules, but "closed-in" under Suez rules. The presence of cargo requires measurement forever thereafter.	Same as United Kingdom.	Measured unless "open" according to rules of Commissioner of Navigation.
Deck loads	Added to net tonnage for tonnage taxation.	Exempted	Exempted	Exempted.
Water ballast tanks (not double bottoms).	Measured	Measured	Measured	Measured.
Double bottoms	Exempted if used exclusively for water ballast.	Exempted	Same as United Kingdom.	Same as United Kingdom.
Between-deck spaces	Measured	Measured	Measured	Measured.
Spaces under tonnage deck	do	do	do	Do.

By applying the several sets of rules described in this chapter to the measurement of the same vessel, the results obtained indicate the main differences in the rules. In the latter part of 1911 the surveyor at the port of New York, at the request of the Commissioner of Navigation, had the British, Suez, and American rules applied to each of eight vessels, and the American, German, and Suez rules were applied to two other vessels. In the note appended to this chapter the details of the measurement of each of these vessels are presented. The following summary table compares the gross tonnage of the eight vessels whose tonnage was determined by British, Suez, and American rules:

TABLE II.—*Gross tonnage of steamers measured by British, Suez, and American rules.*

Name of steamer.	British rules.	Suez Canal rules.	American rules.
Kentuckian	6,514.59	6,568.61	6,515.52
Voltaire	8,617.65	8,776.56	8,617.65
Stephen	4,434.84	5,477.70	5,470.32
Santa Rosalia	5,409.43	5,580.17	5,833.97
Kirkdale	4,731.63	5,100.73	5,352.47
Ikala	4,322.39	4,317.19	4,684.97
Tunstall	3,825.27	3,778.76	3,939.63
Benwood	3,869.40	4,110.83	4,234.19
Average	5,215.65	5,463.82	5,581.09

The first vessel mentioned in Table II, the *Kentuckian*, is an American ship with three decks, and the second vessel, the *Voltaire*, is an English steamer, also with three decks. In measuring both vessels all three rules included in the measurement all spaces under the upper deck. In other words, the space under the upper deck was not treated as a shelter-deck space. The third ship mentioned, the *Stephen*, is a British vessel with two decks and a third deck treated by the British measures as a shelter deck. Under the Suez and American rules, however, the space under this deck was considered to be closed-in and for this reason, mainly, the gross tonnage under the British rules is a thousand tons less than under the Suez and American rules. The *Santa Rosalia* is a British well-deck cargo steamer, to which the same below-deck tonnage is given by all three measurements. The differences in gross tonnage are due to the spaces exempted by the several rules as applied to superstructures. The *Kirkdale* and *Ikala* are two-decked British steamers, the gross tonnage of which, under the Suez and American rules, exceeds the tonnage under the British rules mainly because the Suez and American rules consider as closed large bridge spaces which are held under the British rules to be open. The *Tunstall* is a one-deck turret steamer built in Great Britain. Its under deck and turret tonnage by the three rules is nearly the same, but the gross tonnage of the vessel is made appreciably larger by the American rules than by the other two measurements because of the inclusion in the American measurement of large bridge spaces exempted by the other rules. The *Benwood* is a British freight steamer with one deck. Its tonnage under the Suez and American rules is greater than as measured by the British rules, because of the inclusion of superstructures which under the British rules were considered open.

For most of the eight vessels listed in the preceding table the gross tonnage is made least by the British rules and highest by the American rules. The lower tonnage figures under the British rules are due mainly to the exemption of above-deck spaces which the American and Suez rules consider closed, and thus subject to measurement. The Suez gross tonnage is somewhat less than the American, because the Suez rules consider open, and thus exempt from measurement, certain above-deck spaces that are not exempted by the American rules.

The following table compares the gross tonnage of two German vessels as determined by the application of the Suez, German, and American rules. The *Patricia* mentioned in the table is a relatively large freight and passenger steamer with four decks. The *Duisburg* is a medium-sized two-deck cargo steamer.

TABLE III.—*Gross tonnage of two German steamers measured by Suez, German, and American rules.*

Name of steamer.	Suez Canal rules.	German rules.	American rules.
Patricia	14,453	14,466	14,466
Duisburg	5,255	4,496	5,156

The measurements of the steamer *Patricia* under the German rules were accepted by the American admeasurers at New York without change. The Suez rules exempted portions of superstructures that were included in the German and American measurements. The wide discrepancy between the gross tonnage of the *Duisburg*, as measured by the German rules and as determined by the American and Suez rules, is due to the exemption, under the German rules, of large spaces which the other rules considered as "closed-in" and subject to measurement. The German definition of open and closed superstructures follows the English definition and practice, whereas the Suez and American rules, as has been explained, consider superstructures as closed-in whenever they are or may be used for the accommodation of passengers and cargo.

The effect of the definition of closed and open spaces upon the tonnage of vessels is well illustrated by the *Duisburg*. Under the German and British law the bridge house and poop of this ship were considered as open spaces above the upper deck. The surveyor of New York, however, considered the bridge and a part of the poop as permanent closed-in spaces, and added 1,817 cubic meters, equal to 642 tons, to the vessel's gross tonnage. When measured by the Suez rules, the entire poop and bridge were treated as closed-in, and 2,173 cubic meters, equivalent to 767 tons, were added to the vessel's gross tonnage. Other variations in the measured spaces account for the difference in the *Duisburg's* tonnage as determined by the Suez, German, and American rules.

DETAILS OF THE MEASUREMENT AND TONNAGE OF VESSELS TO WHICH THE BRITISH, SUEZ, AMERICAN, AND GERMAN MEASUREMENT RULES WERE APPLIED IN THE DETERMINATION OF GROSS TONNAGE.[1]

VESSELS TO WHICH THE MEASUREMENT RULES WERE APPLIED.

The steamship *Kentuckian* is an American steamship, representative of the fleet of the American-Hawaiian Steamship Co., the largest American fleet which will make use of the canal. She is described as a three-decked ship, but Lloyd's Register describes her as a two-decked ship with deep framing and a shelter deck. The ship is a freight steamer with accommodations, however, for a number of cabin passengers. She carries 280,000 gallons of oil as fuel, the daily consumption being 10,000 gallons at a speed of about 11½ knots.

The British steamship *Voltaire* is a passenger and freight steamer belonging to the Lamport & Holt Line, of the type in trade between New York and Rio Janeiro. She is a three-decked ship with 1,200 tons coal capacity, and, on an average daily consumption of 60 tons, steams at a speed of about 12 knots.

The British steamship *Stephen* is a freight steamer, with accommodations for some passengers, of the type in trade between New York and the River Amazon, owned by the Booth Steamship Co. She has two decks and a shelter deck, with a coal capacity of 1,100 tons, and, on 32 tons consumption per day, has an average speed of about 11 knots.

The steamship *Santa Rosalia* is a modern British well-deck cargo carrier, steaming 10 knots, on a daily coal consumption of 33 tons, and has 1,896 tons coal capacity.

The British steamship *Kirkdale* is a two-decked ship (spar deck) cargo steamer, steaming 10 knots, on a daily coal consumption of 30 tons, with a coal capacity of 1,800 tons.

The British steamship *Ikala* is a two-decked ship to which at New York the surveyor of customs appears to have added the bridge space, making substantially the difference between the American and British measurement. This bridge space was not included in the Suez Canal certificate issued in 1901. If, however, cargo should be carried in that space hereafter it would be added to the Suez measurement. The steamship *Ikala* is being converted into an oil-burning steamer.

The British steamship *Tunstall* is a one-decked (turret) steamer.

The British steamship *Benwood* is a one-decked freighter. The bridge and poop were added to the gross tonnage at New York on the ground that they were permanent closed-in spaces.

The German steamship *Patricia*, of the Hamburg-American Line, was built in 1899, and is a four-decked passenger and freight steamer, steaming from 12 to 13 knots, on a daily coal consumption of 96 tons, and has a coal capacity of 1,620 tons.

[1] These details are copied with certain changes and abbreviations from the statement submitted by the Commissioner of Navigation to the Committee on Interstate and Foreign Commerce of the House of Representatives, Jan. 20, 1912. Consult Hearings before Committee on Interstate and Foreign Commerce, House Doc. No. 680, 62d Cong., 2d sess., pp. 857–872.

The German steamship *Duisburg* is a cargo vessel of 12 knots; daily coal consumption, 40 tons; coal capacity, 1,000 tons; built for trade between Germany and Australia. Under the German and British laws the bridge house and poop are reckoned as shelter spaces above the upper deck not permanently closed-in. The surveyor at New York, in November, 1910, treated the bridge and part of the poop as permanent closed-in spaces, adding 1,817 cubic meters to the vessel's gross tonnage. At Suez the entire poop and bridge are treated as closed-in with a consequent addition of 2,173 cubic meters.

AMERICAN-HAWAIIAN STEAMSHIP "KENTUCKIAN."

[Measured at New York, Nov. 22, 1911. Built at Sparrows Point, Md., 1910.]

Description and dimensions.—Register length, 403.2 feet; register breadth, 53.7; register depth, 28.1; height under spar deck, 7.5; tonnage length, 415.4; number of divisions of length, 16; tonnage depth amidships, 27.7; number of divisions of depth, 6; number of decks, 3; number of masts, 2; head, plain; stern, elliptic.

Tonnage under the measurement rules of the United States.

	Tons.
Under tonnage deck (including feed-water tank)	4,908.20
Between deck	1,441.44
Deck houses	104.24
Side houses	47.16
Skylight	.08
Companionway	.48
Excess of hatchways	13.92
Gross tonnage	6,515.52

Tonnage under the laws of Great Britain.

	Tons.
Under tonnage deck (including feed-water tank)	4,825.77
Between decks	1,450.24
Deck houses	104.24
Side houses	47.16
Second tier:	
Roundhouses	65.17
Chart room	7.52
Skylight	.08
Companionway	.48
Excess of hatches	13.93
Gross tonnage	6,514.59

Tonnage under the Suez rules.

	Tons.
Under tonnage deck (including feed-water tank under boiler and engine)	4,825.77
Between decks	1,450.24
Deck houses	104.24
Side houses	47.16
Roundhouses	65.17
Skylight and companionway	.56
Galley, cookhouses, water-closets, and lavatories, exclusively used for officers and crew	15.77
Chart house, lookout house, signal house, wheelhouse, and steam stearing gear	45.90
Excess of hatchways	13.65
Gross tonnage	6,568.61

BRITISH STEAMSHIP "VOLTAIRE," OF LIVERPOOL.[1]

[Built of steel, at Portick, 1907.]

Descriptions and dimensions.—Number of decks, 3; number of masts, 2; head, straight; stern, elliptic; register length, 485.3 feet; register breadth, 58.25 feet; register depth, 26.2 feet.

Tonnage stated in the British register issued at Liverpool, Mar. 13, 1907.

	Tons.
Under tonnage deck	6,023.52
Between decks	1,956.91
Deck houses	560.31
Side houses	30.02
Chart house	6.10
Light and air	40.79
Gross tonnage	8,617.65

[1] There being no omissions not authorized by the laws of the United States, the British tonnage was accepted by the New York surveyor.

Tonnage stated in the Suez Canal certificate issued by the British Board of Trade, Mar. 30, 1911.

	Tons.
Under tonnage deck	6,064.00
Between decks	1,956.91
Roundhouses	605.30
Side houses	30.02
Galleys, cookhouses, water-closets, lavatories, and bathrooms	93.14
Wheelhouse, chart house, etc	27.19
Gross tonnage	8,776.56

THE BRITISH STEAMSHIP "STEPHEN."

[Built of steel, in 1910, on the Tyne.]

Dimensions.—Registered length, 376.5 feet; registered breadth, 50.3 feet; registered depth, 23.6 feet.

Tonnage under measurement rules of the United States.

	Tons.
Under tonnage deck	3,607.36
Forecastle	84.92
Bridge space	303.10
Poop	177.78
Side houses	7.62
Deck houses	196.78
Light and air	57.28
Upper between decks added	968.94
Light and air added	54.99
Excess hatchways added	11.55
Gross tonnage	5,470.32

Tonnage stated in British certificate.

	Tons.
Under tonnage deck	3,607.36
Forecastle	84.92
Bridge space	303.10
Poop	177.78
Side houses	7.62
Deck houses	196.78
Light and air	57.28
Gross tonnage	4,434.84

Tonnage stated in Suez Canal certificate.

	Tons.
Under tonnage deck	3,607.36
Between decks	1,256.41
Bridge space	347.07
Roundhouses	115.26
Side houses	2.52
Galley, cookhouses, water-closet, and bath	70.53
Chart house, wheelhouse, etc	46.68
Excess hatchways	31.87
Gross tonnage	5,477.70

BRITISH STEAMSHIP "SANTA ROSALIA," OF LONDON.

[Built of steel at port Glasgow, 1911.]

Description and dimensions.—Number of decks, 2; number of masts, 2; head, plain; stern, elliptic; register length, 406 feet; register breadth, 52.6 feet; register depth, 27.7 feet.

Tonnage stated in the British register, issued at London, Oct. 11, 1911.

	Tons.
Under tonnage deck	4,969.98
Houses under bridge	50.16
Side houses under forecastle	68.22
Houses under poop	10.85
Side houses	34.00
Deck houses	96.75
Chart house	3.99
Light and air	138.67
Excess hatchways	36.81
Gross tonnage	5,409.43

Tonnage under the measurement rules of the United States.

	Tons.
Under tonnage deck	4,969.98
Houses under bridge	50.16
Side houses under forecastle	68.22
Houses under poop	10.85
Side houses	34.00
Deck houses	96.75
Chart house	3.99
Light and air	137.24
Excess hatchways	32.76
Bridge space added	323.27
Poop added	106.75
Gross tonnage	5,833.97

Tonnage stated in the Suez Canal certificate, issued by the British Board of Trade, Oct. 23, 1911.

	Tons.
Under tonnage deck	4,969.98
Forecastle	64.13
Bridge space	324.26
Poop	16.48
Roundhouses	81.15
Galleys, cookhouses, water-closets, lavatories, and bathrooms	32.36
Wheelhouses, chart house, house for donkey boiler, and other closed-in spaces used for working the ship	54.27
Hatchways	37.54
Gross tonnage	5,580.17

BRITISH STEAMSHIP "KIRKDALE," OF GLASGOW.

[Built of steel at port Glasgow, 1909.]

Description and dimensions.—Number of decks, 2; number of masts, 2; head, plain; stern, elliptic; register length 400 feet; register breadth, 51.85 feet; register depth, 26.9 feet.

Tonnage stated in British register, issued at Glasgow, Dec. 16, 1909.

	Tons.
Under tonnage deck	4,491.77
Forecastle and sides	66.15
Side houses	43.72
Deck houses	53.85
Chart house	4.85
Light and air	34.49
Excess hatches	36.80
Gross tonnage	4,731.63

Tonnage under the measurement rules of the United States.

	Tons.
Under tonnage deck	4,491.77
Forecastle	66.15
Side houses	43.72
Deck houses	53.85
Chart house	4.85
Light and air	34.49
Excess hatches	25.77
Bridge space added	388.31
Poop space added	165.45
Light and air added	78.11
Gross tonnage	5,352.47

Tonnage stated in Suez Canal certificate, issued by the British Board of Trade, Jan. 8, 1910.

	Tons.
Under tonnage deck	4,491.77
Forecastle	66.21
Bridge space	271.50
Poop	48.90
Roundhouses	158.28
Galleys, cookhouses, water-closets, lavatories, and bathrooms	22.74
Wheelhouse, chart house, and steering house	14.37
Hatchways	26.96
Gross tonnage	5,100.73

BRITISH STEAMSHIP "IKALA," OF LIVERPOOL.

[Built of steel at Yoker, 1901.]

Description and dimensions.—Number of decks, 2; number of masts, 2; head, plain; stern, elliptic; register length, 385.1 feet; register breadth, 48.7 feet; register depth, 27.05 feet.

Tonnage stated in British register, issued at Liverpool, July 8, 1901.

	Tons.
Under tonnage deck	4,036.82
Poop	109.94
Roundhouses	85.24
Forecastle	34.44
Excess hatchways	26.93
Light and air	29.02
Gross tonnage	4,322.39

Tonnage as amended by application of the measurement rules of the United States at New York, May 18, 1910.

	Tons.
Under tonnage deck	4,036.82
Poop	109.94
Roundhouses	85.24
Forecastle	34.44
Excess hatchways	26.93
Light and air	29.02
Light and air added	93.96
Bridge added	268.62
Gross tonnage	4,684.97

Tonnage stated in the Suez certificate, issued by the British Board of Trade. July 11, 1901.

	Tons.
Under tonnage deck	4,036.82
Poop	109.94
Forecastle	34.44
Roundhouses	77.94
Galleys, cookhouses, water-closets, and bath	17.42
Wheelhouse, chart house, etc	13.67
Hatches	26.96
Gross tonnage	4,317.19

BRITISH STEAMSHIP "TUNSTALL," OF WEST HARTLEPOOL.

[Built of steel at Sunderland, 1907.]

Description and dimensions.—Number of decks, 1; number of masts, 2; head, plain; stern, elliptic; register length 350 feet; register breadth, 50.1 feet; register depth, 22.4 feet.

Tonnage stated in British register, issued at West Hartlepool, Feb. 21, 1907.

	Tons.
Under tonnage deck	3,127.77
Turret	467.26
House in bridge	7.40
Poop	65.31
Forecastle (houses in)	4.98
Roundhouses	66.54
Side houses	.84
Excess hatches	27.68
Light and air	57.49
Gross tonnage	3,825.27

Tonnage as amended by application of the measurement rules of the United States, at Tampa, Fla., Nov. 27, 1907.

		Tons.
Under tonnage deck, including turret		3,595.03
Poop		65.31
Forecastle		4.98
Excess hatchways		27.68
Bridge	240.28	
Less space above engine	20.22	
Less donkey boiler and stack casing	30.16	
Less hatchways	18.05	
	68.43	
		171.85
Bridge house		7.40
Roundhouses		66.54
Side houses		.84
Gross tonnage		3,939.63

Tonnage stated in the Suez Canal certificate, issued by the British Board of Trade, Feb. 27, 1907.

	Tons.
Under tonnage deck	2,995.71
Forecastle	5.20
Poop	65.31
Turret	526.90
Roundhouses	67.41
Side houses	.84
Galleys, cookhouses, water-closets, lavatory, and bath	22.04
Wheelhouse, chart house, etc	67.66
Hatches	27.69
Gross tonnage	3,778.76

BRITISH STEAMSHIP "BENWOOD," OF LIVERPOOL.

[Built of steel at Stockton-on-Tees, 1910.]

Description and dimensions.—Number of decks, 1; number of masts, 2; head, plain; stern, elliptic; register length, 345 feet; register breadth, 51.2 feet; register depth, 25.4 feet.

Tonnage stated in the British register, issued at Liverpool Jan. 12, 1910.

	Tons.
Under tonnage deck	3,671.83
Poop	28.90
Side houses	30.62
Deck houses	92.46
Trunk hatch	.24
Excess hatches	45.35
Gross tonnage	3,869.40

Tonnage as amended by application of the laws of the United States at New York, Nov. 9, 1911.

	Tons.
Under tonnage deck	3,671.83
Poop	28.90
Side houses	30.62
Deck houses	92.46
Trunk hatch	.24
Bridge, added	253.08
Poop, added	109.68
Excess hatches	47.38
Gross tonnage	4,234.19

Tonnage stated in the Suez Canal certificate, issued by the British Board of Trade, at Liverpool, 1910.

	Tons.
Under tonnage deck	3,671.83
Forecastle	.07
Bridge space	194.99
Poop	84.58
Roundhouses	83.79
Galleys, cookhouse, water-closets, etc	17.26
Wheelhouse, chart house, etc	13.20
Excess hatches	45.11
Gross tonnage	4,110.83

GERMAN STEAMSHIP "PATRICIA," OF HAMBURG.[1]

[Built at Stettin, of steel, 1899.]

Description and dimensions.—Number of decks, 4; number of masts, 4; head, plain; stern, round; register length, 560.12 feet; register breadth, 62.25 feet; register depth, 44.96 feet.

Tonnage stated in the German register, issued at Hamburg Oct. 20, 1910.

	Cubic meters.	Tons.
Under tonnage deck	22,938.9	
Between deck	6,700.3	
Between decks 1 and 2	6,828.7	
Under bridge deck	1,868.6	
Other spaces	2,645.0	
Gross tonnage	40,981.5	14,466.48

Tonnage stated in the Suez Canal certificate, issued at Hamburg Oct. 2, 1910.

	Cubic meters.	Tons.
Under tonnage deck	22,938.9	
Between deck	6,700.3	
Between decks 1 and 2	6,828.6	
Bridge houses	2,120.1	
Houses	2,189.2	
Steering gear, navigation rooms, chart, etc	167.1	
Gross tonnage	40,944.2	14,453.3

GERMAN STEAMSHIP "DUISBURG," OF HAMBURG.

[Built at Flensburg, of steel, 1900.]

Description and dimensions.—Number of decks, 2; number of masts, 2; head, plain; stern, round; register length, 118.66 meters=389.2 feet; register breadth, 14.63 meters=48 feet; register depth, 8.67 meters=28.43 feet.

Tonnage stated in the German register, issued at Hamburg, July 1, 1907.

	Cubic meters.	Tons.
Under tonnage deck	12,079.742	
Poop	117.674	
Forecastle	210.176	
Other spaces	311.936	
Excess hatches	17.852	
Gross tonnage	12,737.380	4,496.295

Tonnage under measurement rules of the United States.

	Cubic meters.	Tons
Under tonnage deck	12,079.742	
Poop	117.674	
Forecastle	210.176	
Other spaces	311.936	
Excess hatches as measured	69.460	
Bridge and part of poop (added)	1,817.861	
Gross tonnage	14,606.849	5,156.21

Tonnage stated in the Suez Canal certificate, issued at Hamburg July 9, 1907.

	Cubic meters.	Tons.
Under tonnage deck	12,079.700	
Poop and bridge	2,173.579	
Forecastle	202.296	
Roundhouses	274.921	
Galley, cookhouse, water-closets, and bath	59.723	
Wheelhouse, chart house, etc	58.243	
Hatches	40.233	
Gross tonnage	14,888.7	5,255 71

[1] There being no omissions not authorized by the laws of the United States, the German tonnage was accepted by the New York surveyor.

CHAPTER V.

NET TONNAGE.

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NET TONNAGE.

The gross tonnage of a vessel includes its entire closed-in capacity; the net tonnage is, approximately, a vessel's capacity available for cargo and passengers. The gross tonnage, as has been explained, is obtained by measuring the contents of the closed-in spaces above and below the upper deck and by dividing the contents thus obtained by 100, if in cubic feet, or by 2.83, if in cubic meters. The net tonnage is ascertained by deducting from the spaces included within the gross tonnage the spaces required for the crew, for the navigation of the ship and for propelling power. A vessel ton, net or gross, is 100 cubic feet, or 2.83 cubic meters. A vessel's net tonnage is its earning capacity in units of 100 cubic feet or 2.83 cubic meters.

These definitions state what gross and net tonnage theoretically are and what they would be in practice, if uniform and exact measurement rules were applied in the same manner in all countries. As a matter of fact, however, the rules for the measurement of vessels to determine their gross and net tonnage are not the same, and the interpretation and application of the rules are not uniform. Vessels of identical construction may vary widely as to gross tonnage, and especially as to net tonnage, when measured and registered in different countries. It is to be hoped that this may not always be the case. It is highly desirable that there should be uniform practice the world over as regards the vessel spaces to be included in gross tonnage, and as regards the spaces to be deducted therefrom in calculating net tonnage.

If international unity in vessel measurement and tonnage is ever secured, it will presumably be brought about by the general adoption by all countries of a set of measurement rules based upon the two principles that must underlie any logical or consistent code of rules; i. e., that gross tonnage shall include the vessel's entire closed-in capacity, and that net tonnage shall include the actual space available for the stowage of cargo and the accommodation of passengers; or, stated differently, that gross tonnage shall represent the entire closed-in volume, and net tonnage the actual earning capacity.

These principles were the basis of the measurement rules formulated for the Suez Canal Co. by the International Tonnage Commission at Constantinople in 1873, and have since been maintained by the company in interpreting and enforcing the rules. The Panama measurement rules recommended in this report are believed to carry out, even more fully than the Suez rules do, the principles that gross tonnage shall equal the entire closed-in volume of vessels and net tonnage the actual earning capacity. The Suez rules and those recommended for Panama, though varying in certain details, are not so dissimilar as to make their unification seem especially difficult.

Should future events harmonize these two sets of rules so that either a Suez or a Panama tonnage certificate will be accepted at either of the canals, a strong reason, and possibly a controlling reason, will exist for the complete international unification of vessel measurement and tonnage. The problems to be dealt with in bringing about common rules and common practice are indicated by the discussion of gross tonnage in the preceding chapter and of net tonnage in the following pages.

The spaces deducted from those included in gross tonnage to ascertain a vessel's net tonnage are of two general categories: (1) Those required for propelling power, and (2) those required to house other machinery, to accommodate the ship's personnel, and, in general, the non-exempted spaces, other than those occupied by the engines and fuel, required for the navigation of the ship. The deducted spaces of the second category may be either in the hull of the vessel below the

uppermost full-length deck or may be in "permanently covered and closed-in spaces" on or above that deck.

The space deducted for propelling power—the space occupied by the engine room, fuel, and the shaft tunnel—is determined by the application of one or more of three rules:

1. The British Board of Trade percentage rule provides that the deduction for propelling power shall be 32 per cent of the gross tonnage in the case of vessels with screw propellers, when the space occupied by engine and boiler rooms is more than 13 and less than 20 per cent of the gross tonnage of the vessel; and shall be 37 per cent of the gross tonnage in the case of vessels with paddle wheels when the space occupied by the engine and boiler rooms is more than 20 and less than 30 per cent of the gross tonnage. To screw-propelled vessels whose actual engine-room space does not come between 13 and 20 per cent of the space included within gross tonnage, and to vessels propelled with paddle wheels whose engine-room space does not come between 20 and 30 per cent of the space included in gross tonnage, the following rule is applied to determine the tonnage to be deducted for propelling power.

2. The Danube rule stipulates that the deduction for propelling power shall be the actual volume or space occupied by the engine and boiler rooms, with the addition of 75 per cent in the case of screw-propelled vessels and with the addition of 50 per cent in the case of vessels propelled by paddle wheels. This is the rule enforced by the Suez Canal Co. for all vessels having movable coal bunkers. In the case of vessels having fixed bunkers the Suez rules allow vessel owners to choose between the Danube rule and the following rule.

3. The actual-volume, or the so-called German, rule provides that the deduction for propelling power shall, in the case of vessels with fixed bunkers, be the tonnage of the space actually occupied by the engine and boiler rooms and fixed bunkers. This rule originated in England and not in Germany, and does not now prevail in Germany. It was, however, in force for a while in Germany and came to be called the German rule in contrast to the British or percentage rule.

In all cases the engine and boiler rooms include the spaces actually occupied by the engines and boilers and by the shaft tunnel or tunnels when the vessel is screw-propelled and the spaces framed-in around the funnels and within the light and air casings above the engine and boiler rooms. It will be explained later, however, that the measurement rules prevailing in different countries treat the light and air and funnel spaces above the engine rooms differently, some rules including more of those spaces than do other rules. The history and a critical discussion of the rules concerning the deduction of propelling power spaces are presented in Chapter IX of this report.

An analysis and comparison of the British, Suez, German, and American measurement rules as regards the provisions concerning the deductions for propelling power and the deductions allowed for the housings and spaces required for machinery other than propelling power, and for officers' and crew's quarters—i. e., the spaces occupied by the men, stores, appliances, facilities, and machinery required for the operation and navigation of the ship—will reveal the factors to be considered in formulating rules for the measurement of vessels using the Panama Canal, and will show to what extent the four sets of rules compared adhere to, and to what extent they disregard, the principle that net tonnage should include and accurately express the actual earning capacity of merchant vessels. The Panama rules will thus be framed with knowledge of the main provisions of existing rules, and may be formulated with a view to avoiding those provisions of the existing rules that do not tally with the principle that net tonnage should accurately state the merchant vessel's earning capacity.

BRITISH NET-TONNAGE RULES.

The largest deductions from gross tonnage to determine net tonnage are for the spaces occupied by the engines, the ship's fuel, the shaft tunnels, and the light and air and framed-in funnel spaces above the engine room. For most freight vessels under the British flag, the deduction for propelling power is 32 per cent of the gross tonnage, such vessels being for the

most part screw steamers so constructed as to bring the engine-room space somewhat above 13 per cent and somewhat under 20 per cent of the entire space included in gross tonnage. For the comparatively small tonnage of paddle-wheel steamers, the deduction for propelling power is 37 per cent of the gross tonnage when the engine and boiler room spaces come between 20 and 30 per cent of the entire space included in gross tonnage. The British measurement rules provide that, as regards screw steamers whose engine-room space does not come between the 13 to 20 per cent limits and paddle-wheel steamers whose engine-room space does not come between the 20 to 30 per cent limits:

> The deduction shall, if the Board of Trade and the owner both agree thereto, be estimated in the same manner, but either they or he may, in their or his discretion, require the space to be measured and the deduction estimated accordingly; and whenever the measurement is so required the deduction shall consist of the tonnage of the space actually occupied by or required to be inclosed for the proper working of the boilers and machinery, with the addition in the case of ships propelled by paddle wheels of one-half, and in the case of ships propelled by screws of three-fourths, of the tonnage of the space; in the case of ships propelled by screws the contents of the shaft trunk shall be added to and deemed to form part of the space.

In actual practice, the Board of Trade applies the Danube rule in deducting propelling power spaces in the case of screw-propelled vessels whose engine-room space does not exceed 13 per cent of the entire space included in the gross tonnage and in the case of paddle-wheel vessels whose engine-room space does not exceed 20 per cent of the entire space included within gross tonnage. The deduction for propelling power space in vessels of relatively high power whose engine-room space, for screw-propelled ships, is 20 per cent or more of the space included in gross tonnage, or (for paddle-wheel steamers) 30 per cent or more of the space included in gross tonnage, is determined by applying the Danube rule. The owner of high-powered vessels being given the choice between the Board of Trade or percentage rule and the Danube rule for determining the space deductions for propelling power would naturally prefer the latter, because the Danube rule would secure a larger deduction. The British act of 1907, however, provides that the total deduction for propelling power space shall, beginning with the 1st of January, 1914, not exceed 55 per cent of the vessel's tonnage remaining after other deductions than those for propelling power have been made.

The British or percentage rule for the deduction of propelling power space is favorable to ordinary freight ships which constitute the major share of the merchant marine under the British flag. Most freight vessels are so constructed that the actual space occupied by the engine and boiler rooms, shaft trunks, and the light and air and framed-in funnel spaces below the upper deck but slightly exceeds 13 per cent of the entire space included within gross tonnage. In the case of a vessel of 6,000 tons gross, whose engine and boiler rooms (including shaft tunnel and measured light and air and funnel spaces) equal 14 per cent of the entire space included in gross tonnage, the deduction for propelling power would be 1,920 tons (32 per cent of 6,000). The deduction for propelling power which this vessel would secure under the Danube rule would be 24½ per cent of the gross tonnage (14 per cent multiplied by $1\frac{3}{4}$), or 1,470 tons.

In addition to the allowances made for propelling power under the British rules the following spaces are deducted from gross tonnage in determining net tonnage:

1. Crew spaces. The law requires that vessels shall provide at least 120 cubic feet and at least 15 superficial feet of space per man. The space per man in the sleeping quarters shall not be less than 72 cubic feet and 12 square feet of floor area. The spaces may be above or below deck.

2. The master's cabin, when used exclusively by him, and the engineers and officers' accommodations, including berths, mess rooms, and reasonable toilet facilities for their exclusive use.

3. The space occupied by boatswains' stores.

4. The space occupied by the helm, capstan, and anchor gear, and the space required for storing charts, signals, and other instruments of navigation. When these spaces are above deck, however, they are not included in gross tonnage and consequently are not deducted therefrom.

5. The space occupied by the donkey engine and boiler when they are connected with the pumps. When the donkey engine and boiler are housed above deck, the space is not included in the gross tonnage and accordingly is not deducted; when connected with the engine room they are deducted as part of the machinery space.

6. Water ballast tanks such as after, peak, and deep tanks. Double-bottom ballast spaces are exempted from gross tonnage.

7. Galleys, bakeries, toilets, and bathrooms for the accommodation and use of the officers, engineers, and crew are deducted if below decks. When such spaces are above decks they are omitted from measurement.

8. In the case of sailing vessels, a space not exceeding 2½ per cent of the vessel's gross tonnage may be deducted when the space is set apart for the storage of sails.

As was stated in the discussion of gross tonnage, the British rules provide that spaces occupied by deck loads are not included within gross tonnage. The space occupied by deck cargoes are, however, measured and added to the net tonnage upon which dues are payable. Deck cargo spaces are not a part of net tonnage, but are merely added to the tonnage upon which dues or taxes are payable.

The "Certificate of Survey," or tonnage certificate issued by the surveyors of the British Board of Trade, is reproduced as Form 1, page 52. The certificate enumerates the spaces that the British acts stipulate may be deducted from gross tonnage in the calculation of net tonnage.

THE SUEZ NET-TONNAGE RULES.

The Suez Canal Co.'s measurement rules, which were formulated by the International Tonnage Commission that met in Constantinople in 1873, apply the Danube instead of the percentage rule in the deduction of spaces for propelling power. The Suez rules also differ from those in force in Great Britain and other countries regarding the deductions for other spaces than those occupied by propelling power.

The Suez rules stipulate, in general, that the following deductions shall be made for the spaces devoted to propelling power:

> The spaces occupied by the engines, boilers, coal bunkers, shaft trunks of screw steamers, and the spaces between decks and in the covered and closed-in erections on the upper deck surrounding the funnels and required for the introduction of air and light into the engine rooms and for the proper working of the engines themselves. Such deductions shall not exceed 50 per cent of the gross tonnage.

In the case of tugs, however, the propelling-power deductions are not limited to 50 per cent of the gross tonnage. The deductions made for the above-named spaces are always determined, in the case of ships having coal bunkers with movable partitions, by applying the Danube rule; that is, the space actually occupied by the engine room, the boiler room, shaft tunnels in screw-propelled vessels, and the spaces framed in between decks for the funnels and for the admission of air and light into the engine room are measured, and the volume of the spaces thus found by measurement is increased by 75 per cent, in the case of screw-propelled vessels, and by 50 per cent, in the case of ships with paddle wheels.

The Suez regulations provide that the owner of vessels with fixed coal bunkers may decide whether the deductions for propelling power shall be made by applying the Danube rule or by measuring the actual space occupied by machinery and fuel. If the actual space is measured for deduction, the deductions include the entire spaces framed in around the funnels and the entire spaces required for the admission of light and air into the engine rooms, above as well as below the upper deck. The rule as to the deduction of light and air and framed-in funnel spaces under the Danube rule has, since 1904, been somewhat flexible. Such spaces located between decks and below a "shelter deck" which the Suez rules treat as closed-in are always included in the engine room, but such spaces when located in inclosed deck erections above the first tier may or may not be included, as the owner may elect; but if the owner elects to have them included in the engine-room space, he thereby forfeits certain exemptions otherwise granted by the rules of 1904. This question is discussed and fully explained in Chapter IX upon the Deductions for Propelling Power.

The deductions other than those for propelling power provided for by the Suez measurement rules include:

1. Spaces for the accommodation of the crew. The accommodations for clerk, purser, stewards, and for the passengers' servants are not included in the deduction.

2. Quarters occupied by the officers. The captain's cabin is not deducted. The cabins occupied by the ship's doctors are deducted when actually occupied by the doctors.

3. Spaces above and below deck occupied by the cookhouses, galleys and bakeries that are exclusively for the use of the officers, engineers, and crew.

4. Spaces for the anchor gear and the capstan and for working the helm if above decks.

5. Rooms for keeping the charts, signals, and other instruments of navigation if above decks.

6. The mess room or rooms for the exclusive use of the officers and engineers, but no deduction is allowed for officers' mess rooms upon ships that carry passengers without providing a mess room for passengers.

7. Bathrooms and lavatories, latrines and closets for the exclusive use of the ship's officers, engineers, and crew.

8. Spaces especially provided for the storage of electric searchlights and wireless-telegraphy appliances, provided these spaces are upon the upper deck.

The total space allowed for deductions other than for propelling power shall not exceed 5 per cent of the entire space included within gross tonnage. The Suez Canal tonnage certificate reproduced in the preceding chapter, Form 3, enumerates the spaces which the Suez measurement rules allow to be deducted from gross tonnage to determine net tonnage.

NET TONNAGE RULES OF GERMANY.

The measurement rules prevailing in Germany are practically the same as the British rules. As is customary in other countries, the deductions allowable in determining net tonnage are divided into two classes—spaces required for propelling power, and spaces for the accommodation of the crew and for the navigation of the ship.

The German measurement rules apply the British Board of Trade rule for propelling-power deductions in such a way as to produce the same results that British admeasurers secure when they apply the rule. When the engine-room space of screw-propelled vessels does not exceed 13 per cent, and when the engine-room space of paddle-wheel vessels is not in excess of 20 per cent of the space included within gross tonnage, the measurement boards in Germany must make the propelling-power deductions according to the Danube rule, unless the Bureau of Registry requires the application of the Board of Trade rule. The law in Germany gives the owner of the vessel no option as to the rule to be applied in making propelling-power deductions for vessels whose engine-room spaces come under the 13 and 20 per cent limits. The British Board of Trade has the right to, and in practice does, require the propelling-power deductions in the case of such vessels to be made according to the Danube rule. Indeed, the practice of applying the Danube rule in such cases prevails in Germany as in Great Britain. When the engine-room space is 20 per cent or more of the space included in gross tonnage in the case of screw-propelled vessels and is 30 per cent or more in the case of vessels with paddle wheels, the owners of the vessels may choose whether the deductions for propelling power shall be in accordance with the Danube rule or the Board of Trade percentage rule. The German regulations are the same in this regard as the British.

As indicated above, the treatment of light and air and funnel spaces above the engine room is slightly different under the German rules from the treatment under the British rules. Under the British rules—

such portion of the space above the crown of the engine room and above the upper deck as is framed in for the machinery or for the admission of light and air shall not be included in the measurement of the space occupied by the propelling power except in pursuance of a request in writing to the Board of Trade by the owner of the ship;

whereas the German regulation is that—

the cubic contents of the spaces above this deck (deck above the engine room) which are intended for lighting and ventilating the engine room are measured;

and

the total contents of these spaces is then added to the contents of the engine room.

In other words, the German rules regularly include the entire light and air and funnel spaces in the measured engine-room spaces, whereas under the British rules the light and air and funnel spaces above the upper deck are included in the measured engine-room spaces only upon consent of the Board of Trade granted upon the written request of the owner of the vessel. Such a request of the Board of Trade is made by the owner of a vessel when it is necessary to increase the space included in the engine room slightly for the purpose of making the engine-room space of screw-propelled ships more than 13 per cent, and of paddle-wheel vessels more than 20 per cent, of the total space included in the vessel's gross tonnage.

The measurement rules or regulations of Germany allow the following deductions of spaces required for the accommodation of the crew and for the navigation of the ship:

1. The spaces used exclusively by the crew whether above or below decks, i. e., sleeping, bathing, lavatory, and toilet rooms, except toilet rooms above decks, which are exempted from measurement.

2. The captain's cabin when used exclusively by the captain.

3. Galleys, cookhouses, and bakeries if below deck; if above deck, they are exempted.

4. Spaces, when located below decks, required for the steering wheel, gong signals, anchor, auxiliary or donkey engines and boilers. If they are above deck, the spaces are exempted from measurement.

5. Spaces used for storage of charts, signal devices, and other navigation instruments.

6. Spaces required for boatswains' stores.

7. Spaces used solely for water ballast. This does not include double bottoms for water ballast, which are exempted from measurement.

8. In the case of sailing vessels a space not in excess of 2½ per cent of the gross tonnage may be deducted when the space is used exclusively for the storage of sails.

As a part of Appendix VI, the three standard forms of German measurement certificates are reprinted in reduced size. Each certificate states what spaces shall be deducted from gross tonnage in the calculation of net tonnage. The first of these certificates, that issued to decked vessels, is also printed as Form 4, page 57.

THE AMERICAN NET-TONNAGE RULES.

It was pointed out in Chapter IV that the American rules concerning gross tonnage differ materially from those in Great Britain. The American rules in the case of so-called shelter-deck vessels often include large spaces which the British rules exempt from measurement. As regards deductions from gross tonnage to ascertain net tonnage, however, the American rules are practically the same as the British. The differences between the net tonnage of a vessel measured under the British and American rules is due mainly to the different treatment of spaces included in or exempted from gross tonnage.

The deductions for propelling power provided for by the American rules are substantially the same as the deductions authorized by the British rules, the only difference between the British and American rules in this regard being that the British rules permit, when the owner of the vessels and the Board of Trade agree thereto, the application of the percentage rule to the deduction of propelling-power spaces for screw-propelled vessels whose engine rooms occupy not to exceed 13 per cent of the space included within gross tonnage (or not to exceed 20 per cent in the case of vessels with paddle wheels). The American regulations require the application of the Danube rule to vessels whose engine-room space does not exceed 13 per cent for screw steamers and 20 per cent for paddle-wheel steamers. As a matter of fact, the Danube rule is

applied in England as in the United States in determining the propelling-power deductions for vessels of this class.

The treatment of light and air and framed-in funnel spaces above the engine room is slightly different in the United States from the treatment in Great Britain. The engine-room space under the American and British rules includes the light and air and funnel spaces below the upper deck, but, if it is necessary to include in gross and net tonnage those spaces above the upper deck in order to bring the vessel within the 13–20 per cent or 20–30 per cent limits, the owner of an American vessel may request the Commissioner of Navigation to include in gross tonnage and in the engine-room space the entire light and air and funnel space above the engine room. Under these conditions, the owner of a British vessel would request the Board of Trade to include in the engine-room space only such portion of the light and air and funnel space above the upper deck as may be needed to make the engine-room space large enough to entitle the vessel to deductions for propelling power under the 32 (for paddle-wheel steamers 37) per cent rule.

The deductions from gross tonnage other than for propelling power allowed under the American rules include the following spaces:

1. Spaces or compartments occupied by or appropriated to the use of the crew. The minimum space per seaman on steamers is 72 cubic feet, with at least 12 square feet per man of floor or deck space. The minimum space upon sailing vessels is 100 cubic feet with 16 square feet of floor or deck space.

2. Any spaces exclusively for the use of the master and reasonable in extent.

3. Spaces used exclusively for the working of the helm, the capstan, and the anchor gear. If such spaces are above deck, they are exempted from gross tonnage and thus are not deducted.

4. Spaces used for keeping charts, signals, and other instruments of navigation.

5. Spaces occupied by donkey engine and boiler if connected with the main pumps of the ship and are below deck.

6. Spaces required for boatswains' stores.

7. Galleys, bakeries, toilets, bathrooms for the accommodation of the officers, engineers, and crew when such spaces are below deck. If above deck, the spaces are exempted from measurement.

8. Water-ballast tanks other than double-bottom ballast spaces. Double-bottom spaces are exempted from measurement, except when they are used to store feed water or are available for cargo, stores, or fuel.

9. Spaces on sailing vessels for the storing of sails not exceeding 2½ per cent of the gross tonnage.

In the preceding chapter, a blank American certificate of admeasurement is reproduced, Form 5, p. 59. The certificate states what spaces shall be deducted from gross tonnage in calculating net tonnage.

COMPARISON OF THE BRITISH, SUEZ, GERMAN, AND AMERICAN NET-TONNAGE RULES.

A brief comparison of the net-tonnage rules above analyzed will bring out the main differences between the British, Suez, German, and American rules. In making this comparison, it should be borne in mind that in determining net tonnage no spaces are deducted that have not been previously included in gross tonnage. The four sets of rules above analyzed vary largely as to the inclusion and exemption of spaces within gross tonnage. This affects the spaces that may be deducted to determine net tonnage. If the deductions were the same under all the rules, the resulting net tonnages would be dissimilar, because of the wide variance in the rules as to gross tonnage.

The provision contained in the four sets of rules regarding deductions for propelling power may be compared as follows:

1. In the United States, Germany, and Great Britain the deductions for engine-room and fuel spaces are made in accordance with the percentage rule for screw-propelled vessels whose

engine-room space is between 13 and 20 per cent—and for paddle-wheel steamers whose engine-room space is between 20 and 30 per cent—of the entire space included within gross tonnage. The deductions for propelling power in the case of screw and paddle-wheel steamers whose engine-room space does not exceed the 13 or 20 per cent limits are determined by the Danube rule in Great Britain, unless the owner and Board of Trade agree to apply the percentage rule. It is the practice of the Board of Trade to require the application of the Danube rule in such cases. In the United States the law requires the deductions for propelling power to be made in accordance with the Danube rule in the case of low-powered steamers under the 13 and 20 per cent limits. In Germany such steamers have their propelling power deductions made in accordance with the Dánube rule, unless the Bureau of Registry orders the measurement boards to apply the percentage rule. It is the practice of the German authorities to apply the same rule that the Board of Trade adheres to. In all three countries the deduction for propelling power, in the case of vessels whose engine-room space is 20 per cent or more (in the case of paddle-wheel steamers 30 per cent or more) of the space included in gross tonnage, is determined by the application of the percentage rule or Danube rule, as the owner of the vessel may prefer.

The measurement rules of the Suez Canal Co. require propelling power deductions to be made in accordance with the Danube rule in the case of all vessels with movable bunkers. The owners of vessels with fixed bunkers may choose whether the propelling power deduction shall be made by applying the Danube rule or by measuring the actual space occupied by the engine room and bunkers. In practice the Danube rule is almost always applied. It is somewhat more favorable to the shipowner than the actual measurement rule would be. The Suez Canal Co. never makes propelling power deductions in accordance with the percentage rule.

The maximum deduction for propelling power, except in the case of tugs, is limited by the Suez rules to 50 per cent of the gross tonnage. In Great Britain, on and after January 1, 1914, the maximum deduction allowed, except for tugs, will be 55 per cent of the tonnage remaining after deductions other than those for propelling power have been made. The American and German rules contain no limitations as to the maximum amount that may be deducted from gross tonnage in the calculation of net tonnage.

The British, Suez, German, and American rules concerning deductions for navigation spaces other than for propelling power contain so many details that the provisions of the several laws may best be compared by summarizing the provisions in tabular form. Table IV states how the several spaces used for navigation, for the accommodation of the crew, and for stores are dealt with in each of the measurement rules under consideration.

TABLE IV.—*Deductions other than for propelling power under the measurement rules of Great Britain, the Suez Canal Co., Germany, and the United States.*

Portion of vessel.	United Kingdom.	Suez Canal.[1]	Germany.	United States.
Spaces for anchor gear, steering gear, and capstan.	Not deducted if above decks, as they are exempted from measurement. Deducted if below decks.	Deducted if above decks; not deducted if below decks.	Same as United Kingdom.	Same as United Kingdom.
Wheelhouse	Not deducted if above decks, as it is exempted from measurement. Deducted if below decks.	do	do	Do.
Chart, lookout, and signal houses.	Deducted	do	Deducted	Deducted.
Sail room on sailing vessels.	Deducted up to 2½ per cent of gross tonnage.	Not deducted	Same as United Kingdom.	Same as United Kingdom.
Boatswain's stores	Deducted	do	Deducted	Deducted.

[1] The following and all other general deductions may not in the aggregate exceed 5 per cent of the gross tonnage for Suez navigation. The 5 per cent does not include the light and air spaces above the engine room. In the United Kingdom, Germany, and the United States the national rules provide no maximum limit other than that the spaces deducted shall be reasonable in size for their intended purposes.

TABLE IV.—*Deductions other than for propelling power under the measurement rules of Great Britain, the Suez Canal Co., Germany, and the United States*—Continued.

Portion of vessel.	United Kingdom.	Suez Canal.	Germany.	United States.
Donkey-engine and boiler room.	If connected with engine room, it is deducted as part of the machinery space; if above decks and not so connected, it is not measured; in all other cases if connected with main pumps of ship it is deducted.	If connected with engine room, it is deducted as part of the machinery space; if connected with pumps, steering gear, anchor gear, or other auxiliaries, it is deducted, but it is not deducted if used for hoisting cargo.	Same as United Kingdom.	Same as United Kingdom.
Galleys, cookhouses, and bakeries.	Not deducted if above decks, as they are exempted from measurement; deducted if below decks.	Deducted when used exclusively for crew and officers.	.....do.....	Do.
Light and air spaces above engine room.	Portions above decks deducted as part of machinery space if owner desires. Spaces below decks are deducted as part of machinery space.	Spaces above decks are deducted in entirety under Danube rule as part of machinery space if owner desires, and are always deducted if German rule is applied. Spaces below decks are deducted as part of machinery space.	Deducted in entirety as part of machinery space.	Spaces above decks are deducted in entirety as part of engine room if owner desires. Spaces below decks are deducted as part of engine room.
Passageways.....	Deducted when serving deducted spaces exclusively.	Not deducted unless fitted with lockers, hammocks, etc., for use of crew or officers, and serving crew or officers' quarters.	Deducted when serving crew or officers' quarters exclusively.	Deducted when serving deducted spaces exclusively.
Toilets or lavatories and bathrooms.	Above decks 1 toilet for every 50 passengers, not exceeding a total of 12, and those used exclusively by crew and officers are exempted from measurement. Deducted if below decks and for exclusive use of crew and officers.	Those used exclusively by crew and officers are deducted.	Same as in United Kingdom.	Same as in United Kingdom.
Crew and officers' quarters.	Deducted (minimum of 120 cubic feet and 15 superficial feet).	Deducted, with exception of those of master, purser, clerk, stewards, and cooks in passenger steamers, etc.	Deducted (minimum 3.5 cubic meters and 1.5 superficial meters).	Deducted (minimum 72 to 100 cubic feet and 12 to 16 superficial feet).
Master's cabin.....	Deducted.....	Not deducted.....	Deducted.....	Deducted.
Doctor's cabin.....	.....do.....	Deducted if actually occupird by doctor.	.....do.....	Do.
Deck loads.....	Added to net tonnage in special memorandum for tonnage taxation.	Not measured.....	Not measured.....	Not measured.
Water-ballast tanks (not double bottoms).	Deducted if used exclusively for water ballast.	Not deducted.....	Same as United Kingdom.	Same as United Kingdom.
Double bottoms.....	Not deducted if used exclusively for water ballast, as they are then exempted from measurement. Deducted as part of machinery space if used for fuel oil.	Not deducted, as they are exempted from measurement.	.....do.....	Do.

Table IV indicates that crew spaces are deducted by all four sets of measurement rules, but the several rules differ as to the minimum amount of space that must be given each member of the crew. The Suez rules, it will be noted, limit the deductions for spaces, other than those required for propelling power, to 5 per cent of the space included within gross tonnage.

All rules provide for the deduction of officers' and engineers' accommodations, including cabins, berths, and mess rooms. The Suez rules, however, are less liberal than the others in this regard. The cabins occupied by the master, purser, clerk, and, in the case of passenger steamers, by the stewards and cooks, are not deducted in calculating net tonnage. The Suez rules permit the doctor's cabin to be deducted only when the cabin is actually occupied by the doctor.

The spaces occupied by galleys, bakeries, toilets and bathrooms for the accommodation of the crew, officers, and engineers, are not included in net tonnage. Under the Suez rules such spaces are deducted whether situated above or below deck, but under the British, German, and American rules these spaces are deducted only when located below deck, for the reason that when such spaces are above deck they are not included in the gross tonnage.

Spaces occupied by the steering gear, chain locker, houses for charts, signals, and other instruments of navigation, lookout houses, houses for donkey boiler and engine connected with the main pumps are deducted from gross tonnage by the British, German, and American rules when such spaces are below decks. If the spaces are above decks they are exempted from measurement under the three national rules. The Suez rules deduct these spaces whether located above or below deck. The space occupied by the donkey engine and boiler when connected with the engine room is by the British, German, and American rules deducted as a part of the engine room space. When the donkey engine and boiler are not connected with the engine room the space occupied by them is not measured if it is above deck. Under the Suez rules, however, the donkey engine and boiler, when located above deck, are measured into gross tonnage and deducted therefrom, if they are connected with the pumps, steering gear, or anchor gear, and are not used for hoisting cargo.

Spaces required for boatswains' stores are deducted by the British, German, and American rules, but not by the Suez rules.

The rules regarding the deductions for light and air and funnel spaces above the engine room are confusing. The British and German rules agree in deducting those spaces below the upper deck and in deducting a part of those spaces above the upper deck upon request of the owner of the vessel. The American rules provide for the deduction of the entire light and air and funnel space above the upper deck when the owner requests that space to be included in the engine room. The Suez rules provide for the deduction of the entire light and air and funnel space if the owner of the vessel desires to accept the conditions that accompany such deduction. When the deductions are made by the measurement of actual engine room and fuel spaces, the entire light and air and funnel spaces are included in the deductions under the Suez rules.

The British and American rules deduct passageways when they serve deducted spaces exclusively. The German rules deduct passageways serving crew, engineers' or officers' quarters, while the Suez rules do not deduct passageways unless they are fitted with lockers, hammocks, etc., for the use of the ship's personnel, nor unless they serve the quarters occupied by the personnel.

In the three national rules sailing vessels are allowed to deduct $2\frac{1}{2}$ per cent of the gross tonnage for spaces in which to stow the sails, but this deduction is not permitted by the Suez regulations.

Water-ballast spaces, other than double-bottom tanks, are deducted under the British, German, and American rules, but not under the Suez regulations. Double-bottom ballast spaces not available for freight, stores, or fuel are exempted by the three national rules. The Suez rules exempt double-bottom spaces from measurement.

The foregoing comparisons of the provisions of the British, Suez, German, and American rules show very clearly that the deductions allowed by the Suez rules are less than those provided for in the three national rules. This, together with the fact that the Suez rules include within gross tonnage more spaces than are included by the British and German rules, accounts for the higher net tonnage given vessels by the Suez than by British or German measurement rules. Moreover, the net tonnage of most vessels when measured by the Suez rules will be larger than when measured by the American rules.

By applying to the same vessel each of the four rules, the differences in the results can be clearly shown. In 1911, the United States Commissioner of Navigation had the admeasurers

at New York apply to eight vessels the British, Suez, and American rules. To two other vessels having German certificates, the Suez and American rules were applied. The note appended to this chapter gives the details of the deductions made from gross tonnage by applying to eight vessels the British, Suez, and American rules and by applying to two vessels the German, Suez, and American rules. Table V states the gross and net tonnage as determined by the British, American, and Suez rules of the eight vessels to which those rules were applied:

TABLE V.—*Gross and net tonnage of eight steamers as determined by the British, American, and Suez measurement rules.*

Vessel.	British rules.		American rules.		Suez rules.	
	Gross.	Net.	Gross.	Net.	Gross.	Net.
Kentuckian	6,514.59	4,085.95	6,515.52	4,116.88	6,568.61	4,875.31
Voltaire	8,617.65	5,532.46	8,617.65	5,532.46	8,776.56	6,544.15
Stephen	4,434.84	2,807.85	5,470.32	3,511.98	5,477.70	4,203.30
Santa Rosalia	5,409.43	3,488.43	5,833.97	4,392.10	5,580.17	4,452.16
Kirkdale	4,731.63	3,047.03	5,352.47	3,469.20	5,100.73	3,928.91
Ikala	4,322.39	2,821.29	4,684.97	3,067.84	4,317.19	3,299.99
Tunstall	3,825.27	2,438.27	3,939.63	2,516.04	3,778.76	2,745.44
Benwood	3,869.40	2,412.80	4,234.19	3,077.68	4,110.83	3,088.54
Average	5,215.65	3,329.26	5,581.09	3,710.52	5,463.82	4,142.23

The first of the eight ships mentioned in Table V, the *Kentuckian*, is of American build and registry, and is one of the fleet that will be operated by the American-Hawaiian Steamship Co. through the Panama Canal. The gross tonnage of this vessel is practically the same under all three rules, British, American, and Suez, and the deductions made from gross tonnage to determine net tonnage are nearly the same under the British and American rules. The Suez net tonnage is greater than the British or American, mainly because of the larger deduction for propelling power authorized by the American and British rules. The 32 per cent rule makes the propelling power deduction in Great Britain and the United States 2,084 tons, as compared with a deduction of 1,496 tons resulting under the Suez regulations from the application of the Danube rule.

The seven vessels other than the *Kentuckian* listed in Table V are all of British registry. The *Voltaire* has the same gross and net tonnage under the British and American rules. The Suez rules give the vessel a somewhat greater gross tonnage and a much larger net tonnage. The propelling power deduction under the 32 per cent rule is 2,757 tons, as compared with a deduction of 2,035 tons under the Danube rule.

The British steamship *Stephen*, mentioned in the table, affords a good illustration of the extent to which different definitions of open and closed spaces may affect gross and net tonnage. The tonnage openings in the uppermost or so-called shelter deck of the *Stephen* caused the space between that deck and the main deck of the vessel to be considered open under the British rules and thus exempted from measurement, whereas under the American and Suez rules this large space between the two decks is included within gross and thus within the net tonnage. The gross tonnage of the *Stephen* under British measurement is 4,434 tons, while under the American rules the tonnage is 5,470, and under the Suez rules 5,477. If this vessel had the same gross tonnage under the British and American rules, it would have the same net tonnage under those two rules. The Suez net tonnage of the *Stephen* is higher than the British or American, because in determining the Suez tonnage the propelling power space is deducted by applying the Danube rule.

The details regarding the measurement of the *Santa Rosalia* give another illustration of the effect which gross tonnage may have upon the net tonnage. Gross tonnage being 424 tons less by the British rules than by the American rules, the engine-room space is equal to over 13 per cent of the entire space included in gross tonnage under the British rules, whereas under

the American rules, the gross tonnage being larger, the engine-room space is less than 13 per cent of the gross tonnage and the propelling power deduction is made under the Danube rule.

The note appended to the end of this chapter, which states in detail the deductions made from gross tonnage, may be consulted for an explanation of the differences in the net tonnage as determined by the British, American, and Suez rules in the case of the *Kirkdale*, *Ikala*, *Tunstall*, and *Benwood*, listed in Table V.

The average gross tonnage of the eight vessels listed in Table V is lowest under the British rules and highest under the American rules. The average net tonnage as determined by the American rules is about midway between the average under the British and Suez measurements.

The gross and net tonnage of two German steamers, the *Patricia* and *Duisburg*, as determined by the German, American, and Suez rules are compared in Table VI.

TABLE VI.—*Gross and net tonnage of two German steamers as determined by the German, American, and Suez measurement rules.*

Vessel.	German rules.		American rules.		Suez rules.	
	Gross.	Net.	Gross.	Net.	Gross.	Net.
Patricia	14,466.48	9,059.54	14,666.48	9,059.54	14,453.3	10,909.1
Duisburg	4,496.295	2,854.276	5,156.21	3,303.02	5,255.71	3,729.38

It will be seen by studying the details in the note appended to this chapter that the German and American rules authorize much larger deductions than do the Suez rules both for propelling power and crew space in the case of the steamer *Patricia* mentioned in Table VI. Under the Suez rules, the deductions for the space occupied by the crew, officers, and engineers was 234 tons (697 cubic meters) less than the deduction made under the German and American rules. The propelling power deduction under the percentage rule was 1,600 tons greater than under the Danube or Suez rule.

The other German steamer mentioned in Table VI, the *Duisburg*, is given a larger gross tonnage under the American and Suez rules than under the German, because the German rules treat as "open" certain spaces under the so-called shelter deck—spaces that are included in the American and Suez gross tonnage. The net tonnage of the *Duisburg* under the American rules is less than under the Suez rules, mainly because of the different deductions made for propelling power. The 32 per cent rule was applied by the American rules, whereas the Suez deductions were made in accordance with the Danube rule.

The dissimilarity in the ratio of gross and net tonnage of vessels as measured and registered under the laws of different countries is brought out by Table VII, which states the aggregate gross and net tonnage of the metal steam vessels of each of the several commercial nations of the world for the years 1890, 1900, and 1910.[1] For convenience of comparison, the gross and net tonnages of the Suez Canal for the three years are added to the table.

[1] This table is taken from the report of the United States Commissioner of Navigation for the year 1911.

TABLE VII.—*Gross and net tonnages of the metal steam vessels of the world, 1890, 1900, and 1910, and the percentage deducted from the gross in ascertaining the net.*

Flag.	1890			1900			1910		
	Gross.	Net.	Per cent deducted.	Gross.	Net.	Per cent deducted.	Gross.	Net.	Per cent deducted.
United States (excluding northern lakes)	357,743	246,024	31	710,324	477,549	32	1,439,911	939,505	34
Argentinian	20,973	12,901	38	56,324	36,422	35	139,346	82,418	40
Austro-Hungarian	149,648	86,036	42	387,103	240,625	37	777,240	485,675	37
Belgian	106,128	71,896	32	162,157	111,380	31	295,913	194,336	34
Brazilian	62,257	37,859	39	129,963	83,490	35	232,425	142,582	38
British	8,125,195	5,086,427	37	12,050,777	7,394,663	38	17,940,862	10,893,898	39
Chilean	30,934	20,503	33	62,872	38,960	38	114,067	72,608	36
Chinese	40,247	25,276	37	62,910	40,039	36	84,800	54,526	35
Cuban				20,022	12,773	36	52,494	32,165	38
Danish	156,902	97,195	38	410,085	239,312	41	668,836	391,788	41
Dutch	214,232	145,393	32	465,975	306,944	34	982,104	607,286	32
French	808,351	494,380	38	1,050,008	541,079	48	1,445,422	835,016	42
German	927,804	637,265	31	2,158,717	1,343,902	37	3,959,147	2,416,370	39
Greek	82,143	53,243	35	177,222	111,281	37	498,281	312,296	37
Haitian	3,139	1,863	40	918	431	53	3,387	2,017	40
Italian	300,205	190,001	36	539,243	342,458	36	985,716	597,640	39
Japanese	109,460	69,854	36	427,958	266,445	37	1,064,169	675,983	36
Mexican	7,462	4,826	35	10,883	6,195	43	27,324	16,513	39
Norwegian	214,816	155,777	27	727,998	444,594	38	1,385,631	838,320	37
Peruvian	2,188	1,478	32	4,869	3,204	34	10,371	5,354	48
Portuguese	44,582	29,122	34	57,443	36,995	35	78,829	48,677	38
Roumanian	529	270	49	17,361	9,686	44	31,688	16,690	47
Russian	152,371	103,597	32	465,147	289,542	37	687,231	400,761	41
Sarawak	2,269	1,406	38	418	244	41	3,953	2,380	39
Siamese	644	408	36	1,435	821	42	12,607	7,792	38
Spanish	403,586	262,676	34	640,695	416,052	35	746,047	459,198	38
Swedish	154,880	116,278	24	393,938	244,549	37	756,909	449,872	40
Turkish	68,472	44,260	35	90,997	56,897	37	110,770	68,753	37
Uruguayan	8,737	5,493	25	10,094	6,232	38	48,337	30,115	37
Venezuelan	2,635	1,553	41	4,246	2,450	42	3,166	1,856	41
Other flags	23,943	14,489	39	33,466	20,340	39	20,657	11,869	42
Philippine				26,748	17,031	36	32,287	20,834	35
Total (national)	12,582,475	8,019,749	36	21,358,316	13,142,585	38	34,639,927	21,115,093	39
Suez Canal	9,749,129	6,890,094	29.3	13,699,237	9,738,152	28.8	23,054,901	16,581,898	28.07

In studying Table VII the fact must be borne in mind that the gross tonnage of vessels in different countries is determined by dissimilar rules, and that the deductions made from gross to determine net tonnage are not the same in different countries. Thus, the ratio of net to gross tonnage, or the percentage which net is of gross tonnage in one country, can not be closely compared with the ratio or percentage in another country. Nevertheless, the percentage of gross tonnage deducted to determine net tonnage indicates in a general way whether the net tonnage rules of any particular country are intended to favor the merchant marine of that country by giving ships a low net tonnage and thus a low basis upon which taxes, port and navigation charges are payable at home and abroad.

Table VIII contains a statement of the net tonnage of the vessels that passed through the Suez Canal during the years 1891, 1892, 1893, and during each year from 1903 to 1912, inclusive. It will be noted that the net tonnage of the Suez Canal shipping was 71.2 per cent of the gross tonnage in 1891, 72 per cent in 1910, and 72.4 per cent in 1912. The gross tonnage of vessels under the Suez rules averages considerably larger than the gross tonnage as determined by the British rules and somewhat higher than the gross tonnage under the American rules. For most vessels the Suez net tonnage is higher than the net tonnage American registry, because the deductions which the Suez rules make for propelling power are less than are made by the American rules.

TABLE VIII.—*Gross and net tonnages of vessels that passed through the Suez Canal, 1891–1893 and 1903–1912.*

Years.	Gross.	Net.	Difference.	Per cent deducted.
1891	12,217,986	8,698,777	3,519,209	28.8
1892	10,866,401	7,712,028	3,154,373	29.9
1893	10,753,798	7,659,068	3,094,730	28.7
1903	16,615,309	11,907,288	4,708,021	28.3
1904	18,661,092	13,401,835	5,259,257	28.7
1905	18,310,442	13,134,105	5,176,337	28.2
1906	18,810,713	13,445,504	5,365,209	28.5
1907	20,551,982	14,728,434	5,823,548	28.3
1908	19,110,831	13,633,283	5,477,548	28.6
1909	21,500,847	15,407,527	6,093,320	28.3
1910	23,054,901	16,581,898	6,473,003	28.0
1911	25,417,853	18,324,794	7,093,059	27.9
1912	28,008,945	20,275,120	7,733,825	27.6

The details presented in this chapter show that net tonnage, though intended to express in a general way the vessel's tonnage or space available for cargo and passengers, varies largely for ships of the same size and type when measured under the rules of different countries. The United States Government is required by its treaty with Great Britain to treat the vessels of all nations with entire equality, so that there shall be no discrimination in respect of the conditions or charges of traffic, and it would doubtless be the policy of the Government to adhere to this principle even though there were no treaty establishing the principle. In order to treat all vessels alike in levying tolls it will be necessary to apply to all vessels the same measurement rules. It will not be possible to charge tolls upon the net tonnage of vessels as stated in their certificates of national registry. There must be a special set of Panama measurement rules. The principles that should control in the formulation of those rules are considered in the chapters that constitute Part II of this report.

DETAILS OF THE DEDUCTIONS FROM GROSS TONNAGE TO DETERMINE THE NET TONNAGE OF VESSELS TO WHICH THE BRITISH, SUEZ, AMERICAN, AND GERMAN MEASUREMENT RULES WERE APPLIED.[1]

VESSELS TO WHICH THE MEASUREMENT RULES WERE APPLIED.

The steamship *Kentuckian* is an American steamship, representative of the fleet of the American-Hawaiian Steamship Co., the largest American fleet which will make use of the canal. She is described as a three-decked ship, but Lloyd's Register describes her as a two-decked ship with deep framing and a shelter deck. The ship is a freight steamer with accommodations, however, for a number of cabin passengers. She carries 280,000 gallons of oil as fuel, the daily consumption being 10,000 gallons at a speed of about 11½ knots.

The British steamship *Voltaire* is a passenger and freight steamer belonging to the Lamport & Holt Line of the type in trade between New York and Rio Janeiro. She is a three-decked ship with 1,200 tons coal capacity, and on an average daily consumption of 60 tons steams at a speed of about 12 knots.

The British steamship *Stephen* is a freight steamer, with accommodations for some passengers, of the type in trade between New York and the River Amazon, owned by the Booth Steamship Co. She has two decks and a shelter deck, with a coal capacity of 1,100 tons, and on 32 tons consumption per day has an average speed of about 11 knots.

The steamship *Santa Rosalia* is a modern British well-deck cargo carrier, steaming 10 knots on a daily coal consumption of 33 tons, and has 1,896 tons coal capacity.

The British steamship *Kirkdale* is a two-decked (spar deck) cargo steamer, steaming 10 knots on a daily coal consumption of 30 tons, with a coal capacity of 1,800 tons.

The British steamship *Ikala* is a two-decked ship to which at New York the surveyor of customs appears to have added the bridge space, making substantially the difference between the American and British measurement. This bridge space was not included in the Suez Canal certificate issued in 1901. If, however, cargo should be carried in that space hereafter it would be added to the Suez measurement. The steamship *Ikala* is being converted into an oil-burning steamer.

[1] These details are copied with certain changes and abbreviations from the statement submitted by the Commissioner of Navigation to the Committee on Interstate and Foreign Commerce of the House of Representatives, Jan. 20, 1912. Consult Hearings before Committee on Interstate and Foreign Commerce, House Doc. No. 680, 62d Cong., 2d sess., pp. 857–872.

The note appended to Chapter IV, pages 63–69, contains the details concerning the gross tonnage of these vessels. The description of the vessels, although contained in the note appended to Chapter IV, is repeated here for convenient reference.

The British steamship *Tunstall* is a one-decked (turret) steamer.

The British steamship *Benwood* is a one-decked freighter. The bridge and poop were added to the gross tonnage at New York on the ground that they were permanent closed-in spaces.

The German steamship *Patricia*, of the Hamburg-American Line, was built in 1899, and is a four-decked passenger and freight steamer, steaming from 12 to 13 knots, on a daily coal consumption of 96 tons, and has a coal capacity of 1,620 tons.

The German steamship *Duisburg* is a cargo vessel of 12 knots; daily coal consumption, 40 tons; coal capacity, 1,000 tons; built for trade between Germany and Australia. Under the German and British laws, the bridge house and poop are reckoned as shelter spaces above the upper deck not permanently closed-in. The surveyor at New York, in November, 1910, treated the bridge and part of the poop as permanent closed-in spaces, adding 1,817 cubic meters to the vessel's gross tonnage. At Suez the entire poop and bridge are treated as closed-in, with a consequent addition of 2,173 cubic meters.

AMERICAN-HAWAIIAN STEAMSHIP "KENTUCKIAN."

[Measured at New York, Nov. 22, 1911. Built at Sparrows Point, Md., 1910.]

Tonnage under the measurement rules of the United States.

	Tons.
Gross tonnage	6,515.52
Deductions under sec. 4153, Rev. Stats., as amended by act of Mar. 2, 1895:	
Crew space	207.63
Anchor gear	22.66
Boatswain's stores	27.45
Fore and aft peak tank used for water ballast	55.94
Propelling power, 32 per cent	2,084.96
Total deductions	2,398.64
Net tonnage	4,116.88

Tonnage under the laws of Great Britain.

	Tons.
Gross tonnage	6,514.59
Deductions:	
Crew space	216.33
Master's cabin, 10.36; water-closet and bath, 3.73	14.09
Anchor gear	22.66
Boatswain's stores	27.45
Chart house	7.52
Fore and aft peak tanks used for water ballast	55.94
Propelling power, 32 per cent	2,084.66
Total deductions	2,428.65
Net tonnage	4,085.94

Tonnage under the Suez rules.

		Tons.
Gross tonnage		6,568.61
Deductions:		
Crew space		41.06
Galley, cookhouse, water-closets, etc		57.41
Steering gear, wheelhouse, chart house, etc		45.90
Officers		43.32
Officers' mess		9.19
Propelling power—		
Actual propelling power	855.10	
Plus 75 per cent	641.32	
		1,496.42
Total deductions		1,693.30
Net tonnage		4,875.31

BRITISH STEAMSHIP "VOLTAIRE," OF LIVERPOOL.[1]

[Built of steel, at Portick, 1907.]

Tonnage stated in the British register, issued at Liverpool, Mar. 13, 1907.

	Tons.
Gross tonnage	8,617.65
Deductions:	
Propelling power, 32 per cent	2,757.65
Crew space	271.22
Boatswain's stores	40.15
Master	10.07
Chart house	6.10
Total deductions	3,085.19
Net tonnage	5,532.46

Tonnage stated in the Suez Canal certificate, issued by the British Board of Trade, Mar. 30, 1911.

	Tons.
Gross tonnage	8,776.56
Deductions:	
Berthing of crew	77.83
Berthing of officers	50.51
Doctor's cabin	7.74
Engineer's mess room	8.91
Officers' bathroom	3.23
Engineers' bathroom	2.50
Galleys, cook houses, water-closets, and lavatories exclusively for use of officers and crew	19.48
Wheelhouse, chart house, steering house and wireless	27.19
Propelling power—	
Actual 1,162.87	
Plus 75 per cent 872.15	
	2,035.02
Total deductions	2,232.41
Net tonnage	6,544.15

THE BRITISH STEAMSHIP "STEPHEN."

[Built of steel in 1910, on the Tyne.]

Tonnage under the measurement rules of the United States.

	Tons.
Gross tonnage	5,470.32
Deductions:	
Propelling power, 32 per cent	1,750.50
Crew space	141.27
Master	9.22
Boatswain's stores	17.71
Chart house	4.73
Water-ballast spaces	34.91
Total deductions	1,958.34
Net tonnage	3,511.98

Tonnage stated in British certificate.

	Tons.
Gross tonnage	4,434.84
Deductions:	
Propelling power, 32 per cent	1,419.15
Crew space	141.27
Master	9.22
Boatswain's stores	17.71
Chart house	4.73
Water-ballast spaces	34.91
Total deductions	1,626.99
Net tonnage	2,807.85

[1] There being no omissions not authorized by the laws of the United States, the British tonnage was accepted by the New York surveyor.

Tonnage stated in Suez Canal certificate.

		Tons.
Gross tonnage		5,477.70
Deductions:		
Propelling power—		
Actual	630.13	
Plus 75 per cent	472.60	
		1,102.73
Crew space		55.61
Doctor, engineers, etc		16.46
Officers		36.81
Galley, water-closet, etc		16.11
Chart house		4.73
Wheelhouse		6.30
Steering gear		28.28
Wireless apparatus		7.37
Total deductions		1,274.40
Net tonnage		4,203.30

BRITISH STEAMSHIP "SANTA ROSALIA," OF LONDON.

[Built of steel, at Port Glasgow, 1911.]

Tonnage stated in the British register, issued at London, Oct. 11, 1911.

		Tons.
Gross tonnage		5,409.43
Deductions:		
Propelling power, 32 per cent		1,731.02
Crew space		121.07
Master		13.36
Boatswain's stores		41.58
Chart house		3.99
Water-ballast space		9.98
Total deductions		1,921.00
Net tonnage		3,488.43

Tonnage under the measurement rules of the United States.

		Tons.
Gross tonnage		5,833.97
Deductions:		
Propelling power (including light and air)	715.37	
Plus 75 per cent	536.52	
		1,251.89
Crew space		121.07
Master		13.36
Boatswain's stores		41.58
Chart house		3.99
Water-ballast space		9.98
Total deductions		1,441.87
Net tonnage		4,392.10

Tonnage stated in the Suez Canal certificate, issued by the British Board of Trade, Oct. 23, 1911.

		Tons.
Gross tonnage		5,580.17
Deductions:		
Berthing of crew		59.79
Berthing of officers		38.86
Officers' and engineers' mess and bathrooms		7.64
Galleys and cookhouses, water-closets and lavatories, exclusively for officers and crew		11.47
Wheelhouse, chart house, and steam steering house		18.68
Propelling power—		
Actual	566.61	
Plus 75 per cent	424.96	
		991.57
Total deductions		1,128.01
Net tonnage		4,452.16

BRITISH STEAMSHIP "KIRKDALE," OF GLASGOW.

[Built of steel, at Port Glasgow, 1909.]

Tonnage stated in British register, issued at Glasgow, Dec. 16, 1909.

	Tons.
Gross tonnage	4,731.63
Deductions:	
Propelling power, 32 per cent	1,514.12
Crew space	126.07
Master	7.50
Chart house	4.85
Boatswain's stores	26.92
After peak tanks	5.14
Total deductions	1,684.60
Net tonnage	3,047.03

Tonnage under the measurement rules of the United States.

	Tons.
Gross tonnage	5,352.47
Deductions:	
Propelling power, 32 per cent	1,712.79
Crew space	126.07
Master	7.50
Chart house	4.85
Boatswain's stores	26.92
Water-ballast space	5.14
Total deductions	1,883.27
Net tonnage	3,469.20

Tonnage stated in Suez Canal certificate, issued by the British Board of Trade, Jan. 8, 1910.

		Tons.
Gross tonnage		5,100.73
Deductions:		
Berthing of crew		70.44
Berthing of officers		30.55
Officers' and engineers' mess rooms and bathrooms		19.66
Galleys, cookhouses, and water-closets, exclusively for officers and crew		16.30
Wheelhouse, chart house, and steering house		14.37
Propelling power—		
Actual	583.14	
Plus 75 per cent	437.36	
		1,020.50
Total deductions		1,171.82
Net tonnage		3,928.91

BRITISH STEAMSHIP "IKALA," OF LIVERPOOL.

[Built of steel, at Yoker, 1901.]

Tonnage stated in British register, issued at Liverpool, July 8, 1901.

	Tons.
Gross tonnage	4,322.39
Deductions:	
Propelling power, 32 per cent	1,383.16
Crew space	86.39
Master	6.84
Chart house	4.98
Boatswain's stores	19.73
Total deductions	1,501.10
Net tonnage	2,821.29

Tonnage as amended by application of the measurement rules of the United States at New York, May 18, 1910.

	Tons.
Gross tonnage	4,684.97
Deductions:	
Propelling power, 32 per cent	1,499.19
Crew space	86.39
Master	6.84
Boatswain's stores	19.73
Chart house	4.98
Total deductions	1,617.13
Net tonnage	3,067.84

Tonnage stated in the Suez certificate, issued by the British Board of Trade, July 11, 1901.

		Tons.
Gross tonnage		4,317.19
Deductions:		
Berthing of crew		30.15
Berthing of officers		20.08
Galleys, cookhouses, etc		4.33
Chart house, lookout, etc		13.67
Officers' mess and bath		5.35
Propelling power—		
Actual	539.21	
Plus 75 per cent	404.41	
		943.62
Total deductions		1,017.20
Net tonnage		3,299.99

BRITISH STEAMSHIP "TUNSTALL," OF WEST HARTLEPOOL.

[Built of steel, at Sunderland, 1907.]

Tonnage stated in British register, issued at West Hartlepool, Feb. 21, 1907.

	Tons.
Gross tonnage	3,825.27
Deductions:	
Propelling power	1,224.09
Crew space	106.78
Boatswain's stores	38.25
Master	13.96
Chart house	3.92
Total deductions	1,387.00
Net tonnage	2,438.27

Tonnage as amended by application of the measurement rules of the United States, at Tampa, Fla., Nov. 27, 1907.

	Tons.
Gross tonnage	3,939.63
Deductions:	
Crew space	106.78
Master	13.96
Boatswain's stores	38.25
Chart house	3.92
Propelling power, 32 per cent	1,260.68
Total deductions	1,423.59
Net tonnage	2,516.04

Tonnage stated in the Suez Canal certificate, issued by the British Board of Trade, Feb. 27, 1907.

		Tons.
Gross tonnage		3,778.76
Deductions:		
Berthing of crew		54.44
Berthing of officers and engineers		33.23
Officers' and engineers' mess		19.08
Galleys, cookhouses, water-closets, etc		14.68
Chart, wheelhouse, steering gear, etc		40.95
Propelling power—		
Actual	497.68	
Plus 75 per cent	373.26	
		870.94
Total deductions		1,033.32
Net tonnage		2,745.44

BRITISH STEAMSHIP "BENWOOD," OF LIVERPOOL.

[Built of steel, at Stockton-on-Tees, 1910.]

Tonnage stated in the British register, issued at Liverpool, Jan. 12, 1910.

		Tons.
Gross tonnage		3,869.40
Deductions:		
Propelling power, 32 per cent		1,238.21
Crew space		91.61
Master		7.49
Boatswain's stores		22.33
Chart house		4.43
Water-ballast space		92.53
Total deductions		1,456.60
Net tonnage		2,412.80

Tonnage as amended by application of the laws of the United States at New York, Nov. 9, 1911.

		Tons.
Gross tonnage		4,234.19
Deductions:		
Propelling power, plus 75 per cent		938.12
Crew space		91.61
Master		7.49
Boatswain's stores		22.33
Chart room		4.43
Water-ballast space		92.53
Total deductions		1,156.51
Net tonnage		3,077.68

Tonnage stated in the Suez Canal certificate, issued by the British Board of Trade, at Liverpool, 1910.

		Tons.
Gross tonnage		4,110.83
Deductions:		
Propelling power—		
Actual	519.73	
Plus 75 per cent	389.80	
		909.53
Crew space		36.61
Officers		29.71
Officers' mess		20.40
Galleys, cookhouse, etc		12.84
Wheelhouse, chart house, etc		13.20
Total deductions		1,022.29
Net tonnage		3,088.54

GERMAN STEAMSHIP "PATRICIA," OF HAMBURG.

[Built at Stettin, of steel, 1899.]

Tonnage stated in the German Register, issued at Hamburg, Oct. 20, 1910.

	Cubic meters.	Tons.
Gross tonnage	40,981.5	14,466.48
Deductions:		
Propelling power, 32 per cent	13,114.1	
Crew space, etc	1,305.6	
Officers, etc	440.8	
Chart	55.9	
Boatswain's stores	125.2	
Water-ballast space	241.2	
Master	34.3	
Total deductions	15,317.1	5,406.94
Net tonnage	25,664.4	9,059.54

(German certificate accepted in the United States.)

Tonnage stated in the Suez Canal certificate, issued at Hamburg, Oct. 2, 1910.

		Cubic meters.	Tons.
Gross tonnage		40,944.2	14,453.3
Deductions:			
Propelling power—			
Actual	4,843.7		
Plus 75 per cent	3,632.7		
		8,476.4	
Crew space		770.4	
Officers		104.0	
Engineers		72.0	
Do		102.9	
Galley, etc		89.7	
Chart house		38.5	
Steering gear		140.2	
Signal room		17.4	
Mess rooms		228.6	
Total deductions		10,040.1	3,544.1
Net tonnage		30,904.1	10,909.1

GERMAN STEAMSHIP "DUISBURG," OF HAMBURG.

[Built at Flensburg, of steel, 1900.]

Tonnage stated in the German Register, issued at Hamburg, July 1, 1907.

	Cubic meters.	Tons.
Gross tonnage	12,737.380	4,496.295
Deductions:		
Propelling power, 32 per cent	4,075.962	
Crew space, etc	210.727	
Officers, etc	189.164	
Chart house, etc	24.737	
Boatswain's stores	127.374	
Master	23.648	
Total deductions	4,651.612	1,642.019
Net tonnage	8,085.768	2,854.276

Tonnage under measurement rules of the United States.

	Cubic meters.	Tons.
Gross tonnage	14,606.849	5,156.21
Deductions:		
Propelling power, 32 per cent	4,674.191	
Crew space	210.727	
Officers, etc	189.164	
Chart house	24.737	
Boatswain's stores	127.374	
Master	23.648	
Total deductions	5,249.841	1,853.19
Net tonnage	9,357.008	3,303.02

Tonnage stated in the Suez Canal certificate, issued at Hamburg, July 9, 1907.

		Cubic meters.	Tons.
Gross tonnage		14,888.7	5,255.71
Deductions:			
Propelling power—			
Actual	2,184.748		
Plus 75 per cent	1,638.561		
		3,823.309	
Berthing for crew		179.606	
Berthing for officers		127.289	
Galley, cookhouse, water-closets, etc		64.984	
Chart house		24.737	
Wheelhouse		33.506	
Signals		8.998	
Officers and engineers' mess		61.438	
Total deductions		4,323.867	1,526.33
Net tonnage		10,564.8	3,729.38

PART II.

PRINCIPLES CONTROLLING PANAMA MEASUREMENT RULES.

CHAPTER VI.

DISPLACEMENT TONNAGE THE BASIS OF TOLLS UPON WARSHIPS.

CHAPTER VI.

DISPLACEMENT TONNAGE THE BASIS OF TOLLS UPON WARSHIPS.

In fixing a schedule of tolls for the use of the Panama Canal and in prescribing rules to determine the tonnage upon which the tolls shall be paid, it is necessary to decide whether or not the same tolls and the same tonnage rules shall apply to warships and to vessels of commerce. The proclamation issued by the President, November 13, 1912, decided this question, in a preliminary way, by making the tolls upon warships 50 cents per displacement ton and upon merchant vessels with cargo or passengers $1.20 per net ton, with a reduction of 40 per cent in the rate for merchant vessels in ballast without cargo or passengers. The reasons for making displacement instead of net tonnage the basis of tolls upon warships need to be set forth in this report, and in order to carry out the President's proclamation it is necessary to stipulate which displacement tonnage—for displacement tonnage has several meanings—shall be subject to the tolls that have been established.

The Suez Canal Co. has but one schedule of tolls and but one set of measurement rules applicable alike to warships and to merchant vessels. This may be due to the fact that the Suez Co.'s tonnage rules were prescribed for the company by an international commission, whose set of rules, as formulated in 1873, the canal company has felt obliged to observe. The application of the Suez measurement rules to warships is a laborious task, and if the Suez Co. were obliged to measure the warships that apply for passage through the canal, it is probable that the company would seek to make displacement, rather than net tonnage, the basis of the charges upon warships. The measurement of warships, however, is performed by the officials of the Governments to which the several warships belong, and inasmuch as fleets of warships make but infrequent use of the Suez Canal, no country has thought it worth while to seek to have the Suez Co. substitute displacement for net tonnage as a basis of its charges.

It is the practice of the British Government to issue a certificate of net tonnage to each vessel in its navy. The vessels of the British Navy enter foreign ports from time to time, and when they do so they are obliged to pay tonnage taxes, and possibly other port charges, based upon net tonnage. The general regulation of the British Government providing for the issue to warships of net tonnage certificates in accordance with the British and Suez rules is as follows:

> The register tonnage according to British rule is to be inserted in all pilotage certificates, and is to be the basis of all tonnage payments at foreign ports by His Majesty's ships, except when entering Port Said or the Suez Canal, in which case the tonnage according to the Danube rule is to be issued. The Board of Trade tonnage certificate, which shows the registered tonnage according to both rules, is furnished to all ships as they are commissioned at home ports. The weight in tons shown in the navy list is in no case to be used for the payment of pilotage, nor to be mentioned in pilotage certificates.

The United States Navy Department does not regularly measure American naval vessels to ascertain their gross and net tonnage. The Chief of the Bureau of Construction and Repair states that—

> Certain types of American naval vessels which have been built under merchant rules have been measured for gross and net tonnage by the representatives of the Department of Commerce, but this practice is not extended at all generally. Many vessels, however, which have used the Suez Canal, and for which there are reasons to believe such provision was desirable, have been calculated, in the bureau, for gross tonnage and Suez tonnage, and certificates of Suez tonnage have been issued to these vessels.

If Panama tolls upon warships were levied upon net tonnage it would be necessary for the vessels of war belonging to countries other than the United States to be specially measured—

probably at the time of their construction—in accordance with the Panama rules. In order to keep an accurate account of the tonnage of ships using the Panama Canal, it will be necessary for American warships, though they may not pay tolls, to report their tonnage according to the rules; and if foreign warships are required to report net tonnage, American naval vessels would need to report the same kind of tonnage. Moreover, the trouble and expense of ascertaining gross and net tonnage of warships would be incurred to obtain figures for a tonnage that would not be a satisfactory basis upon which to levy Panama tolls.

DEFECTS OF NET TONNAGE AS THE BASIS OF TOLLS ON WARSHIPS.

All rules for the measurement and registry of vessels are formulated with reference to vessels of commerce and not with regard to warships. To apply the rules to warships is an arbitrary and cumbersome process, producing tonnage figures that have little significance. It is a misuse of terms to speak of the net tonnage of a warship, because the net tonnage of a vessel is the measure of its earning capacity, i. e., of the space within the vessel that can be used to stow cargo or accommodate passengers. Warships are not built for the transportation of cargoes and passengers. They are fighting machines, the entire capacity of the vessel being used for the purposes of the vessel as an instrument of war.

The results obtained by British admeasurers in applying the British and Suez measurement rules to five representative warships are summarized in the following table. The normal displacement of a British vessel, as is explained on page 104, is the displacement of the warships with "legend" or designated weights of stores, coal, fuel oil, and water aboard. A vessel's normal displacement is the weight of a ship when equipped for the ordinary purposes for which the vessel is intended. It is a somewhat arbitrary statement of the vessel's displacement, but is an approximate expression of the ship's displacement when at sea.

TABLE IX.—*Displacement, and gross and net tonnage, British and Suez measurements, of five British warships.*[1]

Type of ship.	Normal displacement.	Gross tonnage.		Net tonnage.		Ratio of net tonnage to normal displacement.		Ratio of net tonnage to gross tonnage.	
		British.	Suez.	British.	Suez.	British.	Suez.	British.	Suez.
						Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Battleship	16,500	9,509	9,529	6,155	5,699	37.30	34.54	64.73	59.81
Do	14,900	8,523	8,609	5,796	5,269	38.90	35.36	68.00	61.20
First-class cruiser	11,000	7,069	7,123	3,610	3,307	32.82	30.06	51.07	46.43
Second-class cruiser	5,600	3,770	3,812	1,919	1,770	34.27	31.61	50.90	46.43
Third-class cruiser	2,135	1,492	1,520	713	684	33.39	32.03	47.79	45.00

[1] Adapted from E. L. Attwood, Warships, p. 187.

Table IX states the percentage which net tonnage, British and Suez measurements, is of the normal displacement of the two battleships and the three cruisers for which figures are given. The percentage which net tonnage is of gross tonnage is also stated. It will be observed that the Suez rules make net tonnage a lower percentage of normal displacement and also of gross tonnage than do the British rules, whereas in the case of merchant vessels the Suez rules make the net tonnage a higher percentage of the gross tonnage than do the British rules. This indicates that the application of gross and net tonnage rules to warships is artificial and arbitrary.

Some years since, it became necessary for the Bureau of Construction and Repair of the Navy Department of the United States Government to apply the Suez measurement rules to a number of ships in the American Navy. The experience of the bureau in calculating the net tonnage, Suez measurement, of our naval vessels illustrates the difficulty of making such measurements. So many questions arose as to the definition of spaces and as to the application of the rules to particular portions of warships that the bureau was obliged to compile a detailed book of instructions for the guidance of the draftsmen who were assigned the task of

calculating the net tonnage, Suez measurement, of American warships.[1] The book of instructions that was compiled is printed as Appendix XVII of this report.

Table X compares the normal displacement of 22 American naval vessels of different types with their gross and net tonnage as determined by applying the Suez rules to their measurement. The table is especially instructive. It shows a very wide range in the ratio of net tonnage to normal displacement, the net tonnage of the gunboat *Helena* being over 66 per cent of its normal displacement, while for the armored cruiser *Maryland* the percentage is less than 29 and for the monitor *Monadnock* less than 25. The ratio of gross tonnage to net tonnage, as shown in Table X for warships of different types, has such a wide range as to indicate that the net tonnage of a warship is a very arbitrary expression of the size or capacity of the vessel. It will be noted, for instance, that the net tonnage of one of the cruisers of the third class is but 45 per cent of the gross tonnage, whereas for one of the other cruisers of this class the net tonnage is nearly 63 per cent of the gross. For one of the gunboats the net tonnage is 58 per cent of the gross, while for another it is more than 67 per cent. The details contained in Tables IX and X are a strong argument in favor of basing Panama tolls on warships upon their displacement tonnage.

TABLE X.—*Normal displacement, and gross and net tonnage, Suez measurement, of different types of American warships.*

Name of ship.	Type of ship.	Normal displacement.	Suez gross tonnage.	Suez net tonnage.	Per cent which net tonnage is of—	
					Normal displacement.	Gross tonnage.
Wisconsin	Battleship	11,552	6,911	4,257	36.85	61.60
Ohio	do	12,500	8,081	4,810	38.48	59.53
Connecticut	do	16,000	10,350	5,877	36.73	56.78
Maryland	Armored cruiser	13,680	8,785	3,953	28.90	45.00
Montana	do	14,500	9,769	4,509	31.10	46.16
Brooklyn	Cruiser, first class	9,215	6,387	3,368	36.55	52.73
Saratoga	do	8,150	6,007	2,838	34.82	47.24
Columbia	Cruiser, second class	7,350	5,635	2,536	34.50	45.00
Newark	do	4,083	2,766	1,438	35.22	51.99
Olympia	do	5,865	4,122	1,896	32.33	46.00
Albany	Cruiser, third class	3,430	2,256	1,166	33.99	51.68
Cincinnati	do	3,183	2,076	934	29.34	44.99
Marblehead	do	2,072	1,391	626	30.21	45.00
Tacoma	do	3,200	2,475	1,554	48.56	62.79
Bainbridge	Torpedo-boat destroyer	420	509	229	54.52	44.99
Monadnock	Monitor	3,990	1,618	988	24.76	61.06
Farragut	Torpedo boat	279	355	160	57.35	45.07
Shubrick	do	200	231	104	52.00	45.02
Annapolis	Gunboat	1,010	858	560	55.45	65.27
Dubuque	do	1,085	885	568	52.35	64.18
Helena	do	1,392	1,374	921	66.16	67.03
Petrel	do	890	624	362	40.67	58.01

Unless there are special reasons why the tolls upon warships should be levied upon net tonnage, it is desirable to avoid the large amount of labor required to apply gross and net tonnage rules to the measurement of warships. As a matter of fact, the calculation of gross and net tonnage of warships would require a great deal of labor to secure results that are not satisfactory.

[1] In testifying before the Committee on Interstate and Foreign Commerce of the House of Representatives, January, 1912, Mr. R. H. M. Robinson, Naval Constructor then connected with the Bureau of Construction and Repair in the Department of the Navy, made the following statement in regard to the "instructions and regulations" prepared by the bureau for a guide in applying the Suez rules to American ships:

"I attempted to formulate a set of definite instructions that I could hand to the draftsman and tell him how to do these things, and I found that there was an enormous number of questions that might be considered a dozen different ways, so we wrote a letter, through the Secretary of the Navy, to the Suez Canal authorities, in order to get their ruling on these questions. About a year and a half later we found that we still had a lot of questions we did not understand, and we wrote again, and, as a result of that, we have gotten up a book that would be of assistance to us in calculating the registered tonnage of a warship. It was a huge job." (H. R. Doc. 680, 62d Cong., 2d sess., p. 484.)

ADVANTAGES OF DISPLACEMENT TONNAGE AS A BASIS OF TOLLS UPON WARSHIPS.

The first reason why Panama tolls on warships should be based upon displacement tonnage is that the size of warships is everywhere officially stated in units of displacement tonnage. This practice has prevailed since 1872, when displacement became the legal tonnage of British warships. In all countries the tonnage of naval vessels is their displacement.

Originally the British Navy measured warships by the rules that were employed in measuring merchant vessels, but the purpose of the early laws was to ascertain the dead-weight tonnage which vessels were able to carry. When the more primitive measurement rules were supplanted in Great Britain by the "builders' old measurement" rules, which were applied to British vessels from 1713 to 1835, the purpose of measurement was still to determine the dead-weight tonnage of vessels, and the same rules were applied to merchantmen and to warships. The British measurement acts of 1836 and 1854 substituted for the rules that had been used to determine the dead-weight tonnage other rules formulated with a view to ascertaining the cubical capacity of vessels. The capacity ton instead of the dead-weight ton came to be the unit for merchant vessels. The acts of 1836 and 1854, however, were not applied to the measurement of warships for the purpose of giving them their official tonnage rating in the Royal Navy List, but inasmuch as warships were not constructed to carry dead-weights, it was recognized that the b. o. m. tonnage was an inaccurate unit for the rating of warships. It was the custom of British marine architects in designing warships to indicate the size of the ships by their displacement tonnage. This was also the practice of the continental European countries. The practice that had thus for some time prevailed caused the British Government in 1872 to make displacement the legal tonnage of British warships, although for a few years thereafter the Royal Navy List gave for each vessel both its b. o. m. and its displacement tonnage. This practice, however, was soon abandoned, and for many years the official tonnage of the naval fleets of Great Britain and all other nations has been the displacement tonnage of the vessels.

British warships, it is true, carry certificates stating their gross and net tonnage, according to the British measurement rules, and warships, when commissioned, are provided with a Suez Canal tonnage certificate, but these certificates are furnished the warships solely as a basis of tonnage payments at foreign ports and at the Suez Canal. The warship's displacement scale and curves are its real tonnage certificate, and the tonnage as read from the displacement scale and curves carried by every warship may readily be taken as the basis upon which Panama Canal tolls shall be paid.

A second advantage that will result from making displacement tonnage the basis for Panama Canal charges is the approximate fairness of that tonnage as between different classes of war vessels. Vessels of war as well as those of commerce are of many different classes; some are of high and others of low speed; some are heavily armored to resist attack and others are of light construction to give them great mobility. No single tonnage unit can be adopted that will enable warships to be closely compared on a basis of tonnage. In the case of naval vessels, as well as in the case of merchant ships, the most that can be done is to adopt a tonnage unit that will treat different classes of vessels as fairly as it is possible to treat them.

The main types of warships to which the Panama rules must apply are indicated by the following descriptive classification:[1]

(1) First-class battleships, which are characterized by heavy armor, complete armament, moderate speed as compared with fast cruisers, and maximum size. Until recently their normal or official displacement tonnage ranged from 10,288 to 26,000 tons, but battleships are now being built in Great Britain with a tonnage of 30,000. The American battleship *Pennsylvania* is to have a displacement of 31,000 tons.

(2) Armored cruisers, which are generally of somewhat greater speed and less armor and armament than battleships. Their displacement tonnage is about the same as that of battleships, ranging, until recently, from 9,000 to 19,000. Recent development has so reduced the distinction that it is difficult, in some cases, to distinguish between armored cruisers and battle-

[1] R. H. M. Robinson, Naval Construction, chs. 9 and 11.

ships. Several British and German armored cruisers have recently been constructed with displacements about as great as those of the largest battleships—28,000 and 28,800 tons. The terms "battle cruiser" and "cruiser of the line" are, moreover, being applied to some warships, and in some cases it is largely arbitrary whether the vessels are classed as cruisers or as battleships.

(3) Monitors, which are used especially for harbor and coast defense. They are armored vessels which have from 3,000 to 6,000 tons normal displacement.

(4) Unarmored cruisers, including protected cruisers, which are used chiefly for scouting purposes. They have medium offensive qualities and small defensive ability, but are of maximum speed. They are generally smaller than armored cruisers and battleships, and have a normal displacement of 3,000 to 10,000 tons.

(5) Gunboats, which are used for patrol and police duty and are small vessels of 100 to 1,700 tons normal displacement.

(6) Torpedo boats, which have a normal displacement of 30 to 340 tons.

(7) Torpedo-boat destroyers, which are built for maximum speed. Their weight is reduced to the minimum consistent with strength, their normal displacement ranging from 200 to 1,073 tons.

(8) Submarines, which are small vessels of from 40 to 400 tons normal displacement.

The speed qualities and, to some extent, the other characteristics, both of merchant vessels and of warships, are indicated by their coefficients of fineness or block coefficients. Vessels are often compared with reference to their coefficients of fineness. The coefficients of merchant vessels range from 0.4 for fine-lined yachts to 0.8 for freight steamers. The main classes of vessels in the British Navy have coefficients ranging from 0.4 to 0.65, as is well shown by the following statement of the "average values of the coefficient of fineness," contained in Attwood's "Warships":

Battleships	0.6 to 0.65
Cruisers	.5 to .55
Destroyers	.4 to .45

The range of the coefficient of fineness or the block coefficients of selected representatives of different types of vessels in the United States Navy is stated in Table XI. The vessels in the American Navy have practically the same block coefficients as do vessels of corresponding types in the British Navy.

TABLE XI.—*Range of block coefficients of selected representatives of different types of American naval vessels.*

Battleships	0.65 to 0.66
Armored cruisers	.55 to .57
Cruisers	.47 to .55
Torpedo boats and destroyers	.37 to .44
Gunboats	.48 to .54

The coefficient of fineness, as is shown by the facts regarding British and American warships, is less for battleships than for ordinary freight vessels. Moreover, the difference between the coefficient of cruisers and the coefficient of battleships is less than the difference between the coefficients of fast passenger steamers and heavy freight ships. The range in the coefficients of fineness is somewhat narrower for naval vessels than for merchant ships.

Absolute equality of treatment of all ships can not be attained by any single basis of tolls, but approximate fairness can be secured for warships by basing the charges upon displacement tonnage. This is the opinion of such naval experts as Mr. R. H. M. Robinson, who has already been quoted in this chapter. In his testimony before the House Committee on Interstate and Foreign Commerce he stated that—

> The displacement of a warship is the most accurate means of estimating the value of that warship or the power of that warship. It is not an absolutely accurate measurement, but it is the most accurate measure you could name. If a ship has 20,000 tons displacement, it is reasonable to presume that it is twice as valuable from the military standpoint as a 10,000-ton ship or a ship of 10,000 tons displacement.[1]

[1] Hearings on the Panama Canal, Committee on Interstate and Foreign Commerce, H. R. Doc. No. 680, 62d Cong., 2d sess.

In reply to the question whether tolls charged upon displacement tonnage will be fair as between different types of warships, the Chief of the Bureau of Construction and Repair of the Navy Department stated (in a letter dated Mar. 24, 1913) that—

> In view of the services performed and the general status of ownership, etc., of war vessels, the bureau believes that there should be no question that tolls based upon displacement will be fair and equitable, both from the point of view of the canal authorities and the owner of the vessel.

A third advantage which displacement tonnage has as the basis of tolls on warships is the ease and certainty with which the tonnage may be determined. Displacement tonnage can be ascertained for any vessel at any given draft by reading the tonnage from the document showing the displacement scale and curves, which is carried by every warship as one of its necessary papers. Figure 28 reproduces the displacement curves and scale of a representative battleship.

To ascertain the displacement tonnage of a warship the draft of the vessel forward and aft is read and the mean draft is found. The displacement curve and the corresponding scale of tons show what the ship's displacement tonnage is at the vessel's mean draft. In case there is a difference between the draft forward and aft a slight correction must be made, and for that purpose curves of "addition to displacement for 1 foot change of trim" by head or stern are given on each scale. Ordinarily, a warship rides on even keel and the correction, if any, amounts to but a few tons. In any event, the determination of a warship's displacement tonnage from its displacement curves and scale is a simple problem whose solution depends neither upon detailed measurements nor upon arbitrary definitions and rules, as does the problem of ascertaining the gross or net tonnage of a warship.

THE FOUR MEANINGS GIVEN DISPLACEMENT TONNAGE OF WARSHIPS.

The draft of any particular warship, and hence its displacement, depends upon its lading, whether it is light or is partially or fully loaded with supplies, fuel, water, and other weights. Displacement as applied to warships may have the four following meanings:

1. *Normal displacement*, which is the tonnage officially assigned to a warship as its permanent tonnage rating. In the United States Navy normal displacement means the weight of a ship completely equipped with a full complement of officers and men and their belongings, and with all general equipment, armament and machinery, and having on board two-thirds of its full allowance of stores, coal, fuel oil, and water. When each warship is designed it is given an official load line or normal displacement draft. The normal displacement is intended to represent the usual or normal weight of the ship, and, if the same rules and practice prevailed in all countries and at all times, normal displacement might be made the basis of canal tolls. Normal displacement, however, does not have the same meaning everywhere. It depends upon the rules prevailing in different countries with respect to the amount of stores, coal, fuel oil, and water which a ship shall have on board when its displacement is "normal." The rules may also be changed from time to time by any given country, and new rules may be adopted to apply only to new vessels. A warship always retains the normal displacement originally assigned to it, and thus inequalities between old and new vessels are certain to result from alterations in the regulations.

The British practice in determining normal displacement differs from the American. In the United States the general rule is that the normal displacement of a warship is its displacement when the vessel has on board two-thirds of its fuel, stores, and supplies, whereas in Great Britain certain legend weights of stores, coal, fuel oil, and water are assigned to each warship. The weights thus assigned vary according to the special purposes and services of the vessel. Ordinarily these "legend" weights are considerably less than two-thirds of the maximum amounts that may be put aboard vessels. In most British battleships the maximum coal capacity is over 2,000 tons, but the legend weight of coal in many cases is as low as 1,000 tons or 900 tons, and is sometimes even less. Ordinarily the normal weight of coal on a British warship is less than one-half the maximum coal stowage capacity. Similar variations prevail in

FIG. 28. DISPLACEMEN

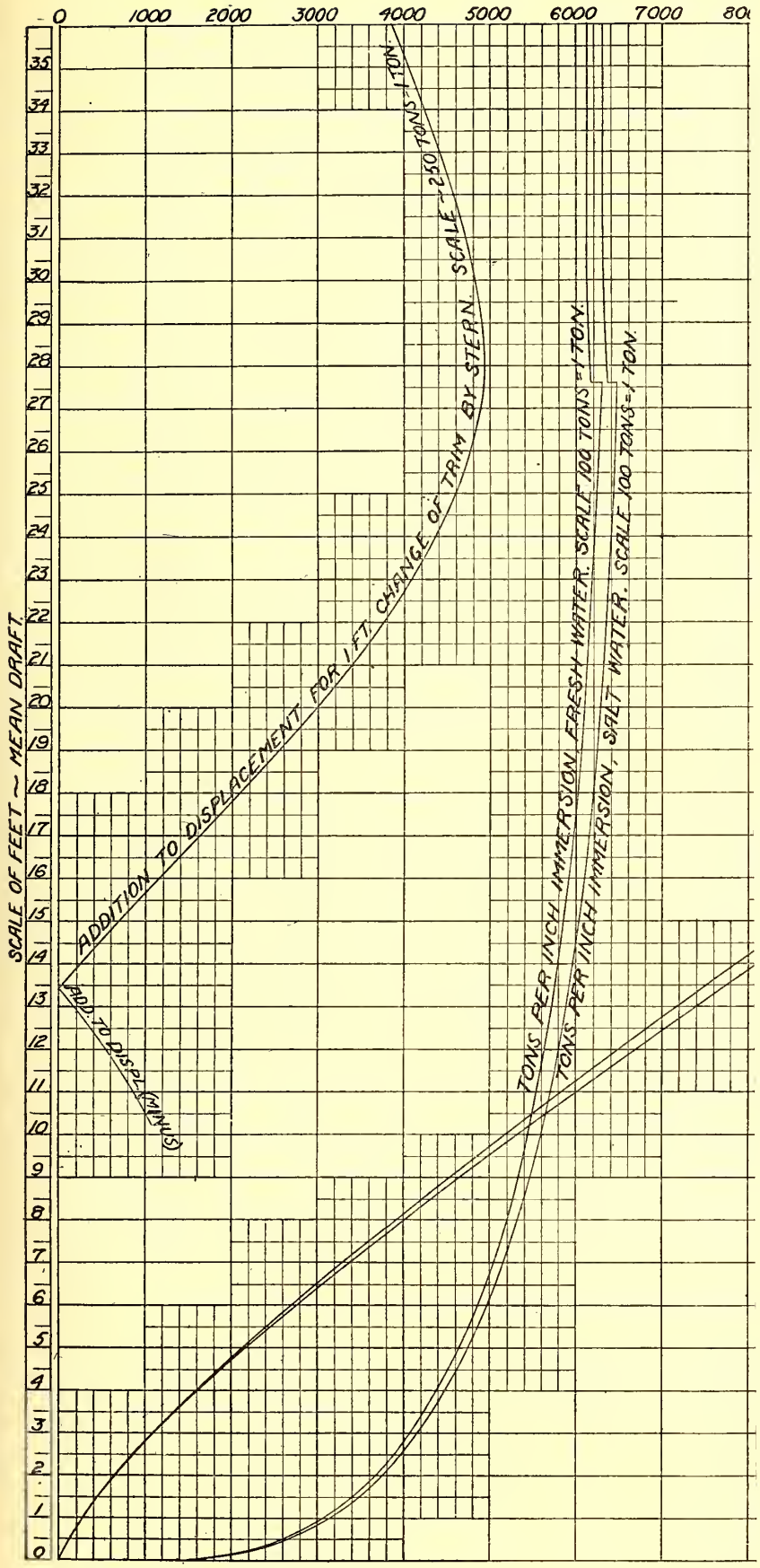
0
1000
2000
3000
4000
5000
6000
7000
SCALE OF FEET ~ MEAN DRAFT
ADDITION TO DISPLACEMENT FOR 1 FT. CHANGE OF TRIM BY STERN. SCALE ~ 250 TONS = 1 TON
ADD TO DISPL. (SHIPS)
TONS PER INCH IMMERSION, FRESH WATER. SCALE 100 TONS = 1 TON.
TONS PER INCH IMMERSION, SALT WATER. SCALE 100 TONS = 1 TON.

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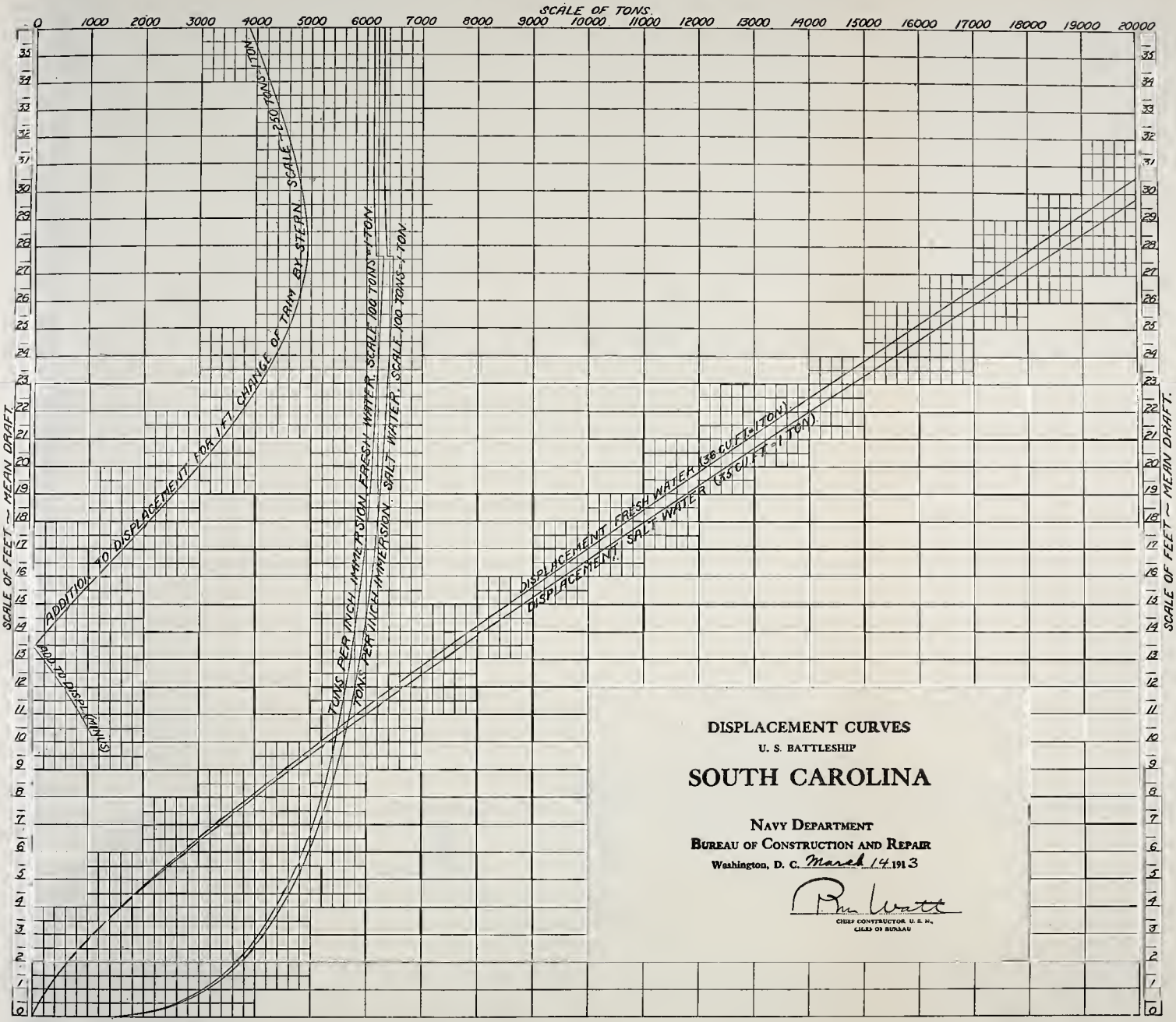
FIG. 28. DISPLACEMENT CURVES U. S. BATTLESHIP SOUTH CAROLINA.


SCALE OF TONS.
0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 11000 12000 13000 14000 15000 16000 17000 18000 19000 20000
SCALE OF FEET ~ MEAN DRAFT.
ADDITION TO DISPLACEMENT FOR 1 FT. CHANGE OF TRIM BY STERN
SCALE 250 TONS = 1 INCH
ADD TO DISPLACEMENTS
TONS PER INCH IMMERSION. FRESH WATER. SCALE 100 TONS = 1 INCH
TONS PER INCH IMMERSION. SALT WATER. SCALE 100 TONS = 1 INCH
DISPLACEMENT. FRESH WATER (36 CU. FT. = 1 TON)
DISPLACEMENT. SALT WATER (35 CU. FT. = 1 TON)
DISPLACEMENT CURVES
U. S. BATTLESHIP
SOUTH CAROLINA
NAVY DEPARTMENT
BUREAU OF CONSTRUCTION AND REPAIR
Washington, D. C. March 14 1913
CHIEF CONSTRUCTOR U. S. N.,
CHIEF OF BUREAU

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other countries, and normal displacement is thus not a standard by which vessels of different countries can be compared. Panama tolls upon normal displacement would not be fair as between different countries and different warships.

2. *Light displacement*, which, in the United States, means the displacement of a warship with complete battery and outfit, but without having on board the officers, the crew and their effects, the ammunition and stores, the water for drinking purposes and for machinery, the fuel of every kind, and the reserve feed water for machinery.[1] Light displacement has a different meaning from this in the case of British warships, in that one-half the carpenters', boatswains' and engineers' stores are assumed to have been consumed, and the remainder to be on board.[2]

The difference between the light displacement rules of the various countries are not so great as are the variations in the regulations concerning normal displacement, but light displacement has unlike meanings in different countries. The lack of uniformity would make light displacement an unfair basis of Panama tolls on warships. Light displacement understates the real tonnage or weight of warships. The toll upon the net tonnage of merchant vessels is a charge upon their earning capacity; the tolls upon warships should be upon fighting machines equipped for service. The actual, rather than the light, displacement indicates the military value of a warship. To exempt from tolls the weight of coal, water, provisions, officers, crew, etc., would be to exempt a necessary part of a warship considered as a fighting machine. There is an inherent difference between merchant vessels and warships. The earning capacity of the vessel of commerce is its space available for cargo and passengers, while the military power of the warship depends upon the entire vessel considered as a unit. The tolls upon a merchant ship are charges upon the vessel as a carrier, and the tolls are logically based upon net tonnage—its earning capacity; the tonnage unit is large and the rate of toll is relatively high. The toll upon the warship is a charge upon its weight as a fighting machine; the tonnage unit (as compared with the net ton) is small, and the rate of toll is made relatively low.

3. *Full-load displacement*, which, in the case of an American warship, is "the displacement of the ship complete in every respect and ready for sea, the vessel having on board her full complement of officers and men, together with their belongings, bunkers and fuel-oil tanks full, reserve feed water tanks full, and all stores and consumables of full allowance in accordance with the allowance books."[1] There is substantial uniformity throughout the world in the calculation of full-load displacement of the ship when equipped and with its maximum capacity of coal, stores, oil, and water.

The objection to full-load displacement as a toll basis is that warships are seldom loaded to their deep-load draft. It is only when beginning unusually long voyages that they attain their maximum displacement, and on such voyages the actual draft upon arrival at the Panama Canal would be less than the full-load draft. Full-load displacement would give too large a tonnage and light displacement too small a tonnage for tolls upon warships.

4. *Actual-displacement* tonnage at the time the warship applied for passage through the Panama Canal. This is the most equitable and practicable basis for the tolls upon vessels of war. The actual displacement of a vessel varies according to the size of the ship and the weight of what it carries. When on a cruise or voyage, its actual displacement is seldom the same as its light, normal, or full-load displacement.

REASONS FOR BASING WARSHIP TOLLS UPON ACTUAL DISPLACEMENT TONNAGE.

A warship's actual displacement at any given draft can be readily determined from its displacement scale and curves, every warship having among its papers a displacement scale and curves such as are reproduced above in Figure 28. Actual displacement of warships at the

[1] Robinson, Naval Construction, p. 350. [2] Attwood, Warships, p. 185.

time of applying for passage through the canal is the logical tonnage upon which to levy Panama tolls. The reasons for making that tonnage the basis may be summarized as follows:

1. Actual displacement will not discriminate between the warships of different countries nor between ships of different types and ages belonging to the same country. Actual-displacement tonnage is not determined by, nor is it at all dependent upon, arbitrary rules, as are light and normal displacement tonnages; it is read off from mathematical scales and curves that are accurate and uniform throughout the world.

As the Chief of the Bureau of Construction and Repair of the Navy Department states (letter of Mar. 24, 1913):

> Due to differences in design classification as adopted in different countries and for different types of war vessels, the terms light, full-load, and normal displacement do not represent fixed and similar definitions for different vessels. For this reason the bureau believes that the displacement upon which the tolls are based should be the actual displacement of the vessel at the time of its application for passage through the canal.

The requirement of the Hay-Pauncefote treaty that vessels of all nations shall be given equality of treatment makes unwise the adoption of either light or normal displacement as the basis for Panama tolls, but, quite aside from the obligations arising from the treaty, it is desirable that the United States should treat the vessels of all nations with equality.

2. For administrative and other reasons it would be inadvisable to levy warship or other tolls upon a tonnage determined by the several national rules. The United States should adhere to the principle of determining the tonnage upon which tolls shall be paid, instead of accepting the tonnage stated in national papers or documents. A vessel's light, normal, or full-load displacement is determined by rules formulated and applied by foreign countries, whereas actual displacement tonnage would be ascertained by the Panama Canal authorities.

3. Tolls upon the tonnage of actual displacement will be charges on the weight of the warships under conditions of actual service. Instead of requiring the vessel to pay tolls upon an arbitrary tonnage, it will be required to pay charges upon its actual weight at the time it is making a voyage that takes it through the canal.

4. The levy of Panama tolls upon the actual displacement of warships will minimize administrative difficulties. The tonnage being readily ascertained from the ship's displacement scale and curves, no code of rules will be needed to check up the accuracy of the light, normal, or full-load lines, or of the tonnages as fixed and determined by the various national rules of the several countries. No quibbles can arise as to the inclusion or exclusion of certain weights. Nor will it be necessary for warships to carry special certificates showing their light, normal, or full-load displacements calculated according to rules prescribed by the Panama Canal authorities. Neither will warships using the Panama Canal have to be specially measured, as is the case with vessels passing through the Suez Canal. The commander of a warship upon applying for passage through the Panama Canal will need merely to present his vessel's official displacement scale and curves, and the tonnage upon which tolls are payable can be determined without delaying the ship.

For the reasons set forth in this chapter, it is recommended that the Panama tolls imposed upon warships by the President's proclamation of November 13, 1912, be levied upon the tonnage of actual displacement of the vessels at the time they apply for passage through the canal. Provisions for giving effect to this recommendation are included in the Panama Measurement Rules embodied in this report.

CHAPTER VII.

NET TONNAGE THE BASIS OF TOLLS ON MERCHANT SHIPS.

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NET TONNAGE THE BASIS OF TOLLS ON MERCHANT SHIPS.

The report upon Panama Canal Traffic and Tolls, submitted in August, 1912, recommended that the charges upon merchant vessels should be levied upon net tonnage, and the President's proclamation of November 13, 1912, made the charges "on merchant vessels carrying passengers or cargo $1.20 per net vessel ton—each 100 cubic feet—of actual earning capacity," with the proviso that vessels in ballast without passengers or cargo should pay tolls 40 per cent less than were charged loaded vessels. The proclamation also stipulated that tolls of $1.20 per net ton should be paid by Army and Navy transports, colliers, hospital ships, and supply ships. Upon naval vessels, other than transports, colliers, hospital ships, and supply ships, tolls were fixed at 50 cents per displacement ton.

In selecting a basis of canal charges upon vessels of commerce the choice lay between displacement, dead-weight, cargo, net, and gross tonnages. Each of these tonnages was briefly defined and explained in the report upon Panama Canal Traffic and Tolls, and they are discussed critically and in detail in Chapters III, IV, and V of this report. The data presented in those chapters make clear the factors involved in selecting any one of these five different kinds of tonnage as the basis upon which Panama tolls shall be levied.

It is especially important that the charges for the use of the Panama Canal shall be in accordance with sound principles, that the tonnage upon which the tolls are paid shall be fair both to the owners of ships and to the United States Government as the owner and manager of the canal, and that the measurement rules employed in determining the tonnage shall be specific, exact, and capable of being easily administered. Moreover, the rules should, if possible, be so formulated as not to require frequent change; for it will be to the advantage of shipping and will make the administration and operation of the canal easier if the measurement and tonnage rules can be made permanent by being so formulated as to be applicable with equal fairness to vessels as they are changed in type and design by the future progress of marine architecture.

The experience of the Suez Canal Co., an account of which is given in Chapters IX, XI, and XII, and Appendix XI of this report, in securing satisfactory tonnage rules and in maintaining and administering the rules that have been in force since 1873, illustrates the administrative difficulties to which measurement rules may give rise. Likewise, the efforts of the British Board of Trade—largely unsuccessful—to bring about the adoption of scientific rules for the determination of gross and net tonnage, shows the importance of seeking to base the Panama rules upon sound and permanent principles and of endeavoring so to frame the rules that they will apply with relative, if not complete, fairness and accuracy to vessels of widely variant types.

The general principle laid down in the President's proclamation is that the Panama tolls upon vessels of commerce shall be levied upon actual capacity, upon the space available for passengers and cargo. This bases Panama tolls upon net tonnage and requires the rules for the measurement of vessels and for the calculation of tonnage to be such that net tonnage will be an exact expression of the space that may be used to accommodate passengers or to stow cargo. In drafting the rules this principle has been adhered to and an effort has been made so to frame the rules that they will apply with accuracy to different classes and types of commercial vessels.

SPECIAL PRINCIPLES TO BE OBSERVED IN DETERMINING THE TONNAGE BASIS OF PANAMA TOLLS.

Vessels being of many types, each of which may vary in design with reference to different classes of service, special care must be taken in formulating a general set or code of measurement and tonnage rules, so to frame the rules that they will, if possible, apply with approximate

fairness to the several kinds of ships. It is desirable not only to adhere to the general and major principle that tolls should be based upon a tonnage that accurately expresses earning capacity, but also to frame the rules so as to meet several additional requirements and conditions. Some of these requirements have been referred to in the preceding paragraphs and are considered in other parts of this report. It will be well, however, to state them in order and to call attention to the significance of each of them:

1. It is essential, first of all, that there shall be one definite set of measurement rules applied to the vessels of all nationalities. If all countries had the same measurement rules and net tonnage had the same significance whatever the nationality of the vessel, it would not be absolutely necessary to have a special set of rules for the measurement of vessels using the Panama Canal. However, tonnage (both gross and net) has different meanings in different countries, and the registered tonnage of vessels, as stated in their certificates of national registry, could not be made the basis of tolls without discriminating unfairly against those countries whose measurement rules make the net tonnage of their vessels relatively large. The commercial treaties of the United States with the leading nations of the world would be violated by international discriminations in charges for the use of the Panama Canal. Moreover, the Hay-Pauncefote treaty between the United States and Great Britain specifically provides that there shall be no discrimination in respect of the conditions of or charges for the use of the Panama Canal. If there were no treaties, it would unquestionably be the policy of the United States to treat the vessels of all nations equally as regards Panama tolls.

2. The tonnage upon which the tolls are collected should be high enough to enable the United States to secure from the Panama Canal the revenue to which the Government is entitled. A reasonable rate of tolls has been fixed by the President's proclamation, which stipulates that the tonnage upon which tolls shall be paid shall be equal to earning capacity in the case of merchant vessels. It would be improper for the United States Government to make the tonnage larger than the earning capacity of merchant vessels, and if net tonnage is made the basis of the charges, it would be unwise to levy tolls upon a tonnage that was appreciably lower than earning capacity. National registry rules that make net tonnage low for the purpose of aiding the national marine may possibly be justified, although it would be better if the measurement rules of all nations were such as to make the net tonnage of ships the world over an exact expression of earning capacity, and gross tonnage the equivalent of the entire closed-in capacity of vessels. Of course, if gross tonnage were made the basis of Panama charges, it would be logical to make the rate of tolls as much lower than a rate based upon net tonnage as gross tonnage is greater than the earning capacity, or net tonnage.

3. The measurement of vessels to determine the tonnage upon which Panama tolls shall be paid must not hamper nor needlessly burden international and intercoastal commerce. The owners of vessels must not be put to unnecessary expense in securing Panama tonnage certificates. The rules incorporated in this report differ from any of the national rules and from those of the Suez Canal Co., but vessels may have their tonnage determined in accordance with the Panama rules by the admeasurers not only at American but at foreign ports at the time vessels are put into service or when they are at their home port preparing for a voyage that will take the vessel through the Panama Canal. It will seldom be necessary to measure vessels at the canal, and although the determination of the Panama Canal tonnage will require careful calculation by official admeasurers, there should be little expense to the owners of vessels, and the passage through the canal need not be delayed by the determination of the tonnage upon which the tolls are to be paid.

4. The administration of the Panama measurement rules should be easy and simple. If the rules shall prove to be so exact and specific as to be applied and interpreted in the same way by admeasurers in different countries, the officials at the canal charged with the collection of tolls will merely need to check up in a general way the figures contained in the tonnage certificates. There will be no need for measuring vessels that arrive at the canal with Panama tonnage certificates. Only a small force of admeasurers will be required at the canal, and the administration of the rules as formulated will be simple and inexpensive.

5. It is desirable that the measurement rules should be as permanent as possible. Frequent changes are to be avoided and should be unnecessary. Accordingly, the rules should be so framed as to apply satisfactorily to the various types of ships that are now in service or that may be constructed in the future. It is hardly to be expected that radical modifications in ship designs will not call for some changes in the Panama measurement rules in order to maintain the principle of charging tolls upon actual cargo and passenger capacity, but if the rules, at the start, are based upon the principle of including within gross tonnage the entire closed-in capacity of merchant vessels and of including in net tonnage the actual earning capacity, and if the rules are made both general in phraseology and specific in their application to spaces, changes in the design of vessels ought to require only infrequent and slight amendments to the rules. Of course, any desired increase or decrease in the revenues from the canal will be made by raising or lowering the rates of toll, and not by changing the measurement rules for the purpose of adding to or lessening the tonnage upon which the charges are payable.

6. The rules adopted for the determination of the tonnage upon which Panama tolls are paid should treat vessels of different types of construction as fairly as possible. Discriminations between vessels should be reduced to a minimum and each ship should bear its fair share of the total amount collected from vessels using the canal. In Chapter II of this report the main classes of freight vessels are briefly described and illustrated by profiles and cross sections. There is such great variation in coefficients of fineness, in engine design and power, in superstructures, and in the general design of vessels as a whole, that Panama tolls can be made approximately fair as between different vessels only by adhering closely to rules based upon accurate general principles.

7. The tonnage selected for the basis of Panama tolls and the rules adopted for the measurement of vessels ought not to place any restrictions upon the size of spaces set aside for the accommodation of the crew, nor in any way to limit provisions that may be made to increase the safety and comfort of crew and passengers. The laws of most nations stipulate the minimum spaces that shall be allowed for the accommodation of the crew. The laws of some nations are more considerate of the comfort of the crews of vessels than are the laws of other countries, and many ships are so constructed as to provide much more than the minimum crew spaces. Whatever spaces are set aside for the use of the crew ought to be deducted from the tonnage upon which tolls are paid. In so far as the Panama rules may afford an inducement to owners of vessels to increase the crew spaces, the rules should be liberal, at least to the extent of exempting such spaces from tolls. The Suez rules limit the deductions for crew spaces and for navigation purposes, i. e., all spaces other than those deducted for propelling power, to 5 per cent of the gross tonnage. Such a restriction is unwise and has not been included in the Panama rules as formulated.

8. The measurement rules should not hinder the construction and use of the best types of ships. The rules should not be such as to dissuade the designers and builders of ships from adopting the latest improvements or from substituting better and more economical engines, or from introducing any other changes that may make vessels safer, more comfortable, and more efficient. It should be the purpose of the United States Government to levy its Panama Canal revenues in such a way as to impose no check upon the technical evolution of ships. If the measurement rules include in the tonnage upon which tolls are paid only the spaces actually available for passengers and cargo, no restrictions will be placed upon the improvement of vessels. Tolls upon the gross tonnage, or entire closed-in capacity, of all vessels would favor slow vessels of low engine power and maximum cargo capacity; but, as regards vessels of any particular type, tolls upon gross tonnage would impose no restraint upon the introduction of more efficient engines. Likewise, as has been pointed out in Chapter III, tolls upon displacement tonnage would be unfair for passenger steamers and for fast freight steamers as compared with slow freight steamers. Similarly, tolls upon the dead-weight tonnage of vessels would unduly burden slow freight steamers—vessels that will make large use of the Panama Canal. Neither gross tonnage, displacement, nor dead-weight tonnage as a basis for Panama tolls

would be as favorable, as would net tonnage, to the introduction of high-powered, and otherwise more desirable, ships into the service through the canal.

9. Unless there are controlling reasons to the contrary, the kind of tonnage upon which vessels ordinarily pay charges should be the basis of the Panama tolls. As has been pointed out, it would be desirable to levy vessel charges upon the same tonnage in all ports of the world and at all canals; but this is impossible for the present and probably will be for some time to come. International uniformity in measurement and tonnage rules has yet to be worked out. In the meantime, however, it will be possible to impose Panama tolls on the same general kind of tonnage—net tonnage—that is made the basis of other charges and taxes on shipping. Light dues, tonnage taxes, charges for the use of ports, docks, and wharves, and in fact practically all charges upon shipping, except for pilotage, whether levied by Governments or corporations, are based upon net tonnage. In most cases the net tonnage upon which these charges are imposed is that stated in the vessel's certificate of registry. It has been shown that it would be inadvisable, and probably impossible on account of our treaty obligations, to collect Panama tolls upon the net tonnage of vessels as stated in their several certificates of registry; but the fact that the charges paid by shipping the world over are imposed upon net tonnage is a strong argument in favor of making net tonnage, accurately and uniformly determined for all shipping, the basis of Panama tolls.

SUMMARY OF REASONS FOR ADOPTING NET INSTEAD OF GROSS TONNAGE AS THE BASIS OF PANAMA TOLLS.

In deciding what tonnage should be made the basis of Panama tolls upon vessels of commerce, the choice lay between gross and net tonnage, and the decision was in favor of net tonnage. Gross tonnage has some advocates, and it will be well to set forth briefly the reasons for basing the tolls upon net tonnage. By applying the foregoing controlling principles or requirements to gross and net tonnage, it will be seen that of the two possible bases of tolls net tonnage is preferable.

It might be said that this analysis of the relative merits of gross and net tonnage as bases of Panama Canal charges has been made unnecessary by the Executive proclamation of November 13, 1912, which fixes rates of toll payable upon net tonnage. Net tonnage was selected as the basis for canal charges after careful consideration of the factors involved; but, in the report upon Panama Canal Traffic and Tolls, the reasons for recommending that tolls be levied upon net tonnage were but briefly presented, and a more complete enumeration of the reasons in this report on measurement and tonnage rules seems appropriate.

The President's proclamation of November 13, 1912, is based upon the general principle that vessels of commerce should pay Panama tolls upon their actual earning capacity—upon the space that may be used to accommodate passengers or to stow cargo. This is, of course, basing tolls upon net tonnage, and in order to justify charging canal tolls upon another basis, such as gross tonnage—the entire closed-in capacity of vessels—it must be shown either that the principle of tolls upon earning capacity, or net tonnage, is not correct and controlling, or that substantially similar treatment can be given vessels of various types and class by charging a lower rate of tolls based upon gross tonnage.

The main arguments favoring gross tonnage are that it can be determined more readily than net tonnage, and that there can be no question or quibble as to what spaces shall be deducted from the tonnage, because there will be no deductions to make. The only uncertainty that can arise in measuring vessels to determine their gross tonnage is as to what spaces shall be exempted from measurement. The several national measurement rules now in force differ as to the spaces exempted from measurement and admeasurers of different countries, the United States and Great Britain, for instance, do not give the same interpretation to identical rules. Thus, while gross tonnage is more readily and definitely determinable than is net tonnage, the application of gross-tonnage rules is not without difficulties, and gross tonnage is not necessarily nor indeed usually a definite and satisfactory statement of the closed-in capacity of a vessel.

If gross and net tonnage be compared with reference to the above list of nine requirements and conditions that must be met by satisfactory measurement rules, it will be found that, in the case of the first five of the nine conditions, gross and net tonnage are on a par, net tonnage having no marked advantage over gross as a basis of Panama tolls upon vessels of commerce.

1. The first essential of any set of measurement rules—that there shall be one definite set of rules applied at Panama to vessels of all nationalities—would be met equally well by making either gross or net tonnage the basis of the canal charges. Whichever tonnage is selected as the basis, it will be necessary to apply one single set of rules to all ships. It will not be possible to accept either the gross or net tonnage of vessels as stated in their certificates of national registry. Indeed, it will be necessary, for reasons that are set forth in the succeeding chapter, to have a special set of Panama rules differing from any now in force.

2. The Government of the United States could secure such revenues as it may desire to obtain from the vessels using the Panama Canal with equal facility and certainty by adopting either gross or net tonnage as a basis of tolls. The one precaution that would need to be taken would be to adopt measurement rules that would make gross tonnage, if that were the basis, equivalent to the closed-in capacity of vessels, or rules that would make net tonnage, were that the basis, an exact expression of the earning capacity of the ships upon which tolls were levied.

3. Panama tolls may be levied either upon gross or net tonnage without interfering with or burdening the commerce using the canal. Panama certificates of gross or net tonnage would be secured by vessels when constructed or when at their home ports, and the certificates would be prepared for the owners of the vessels by official admeasurers without trouble and probably without expense to the owners of the ships. Gross tonnage as well as net tonnage would need to be checked up by canal officials at the Isthmus of Panama and the work of checking up the certificates would be practically the same whether the tolls were levied upon gross or upon net tonnage.

4. The work of administering the Panama measurement rules would be practically the same if tolls were levied upon gross tonnage as they would be if the charges were based upon net tonnage. In either case the administrative problem would be easy and simple.

5. Gross-tonnage rules so formulated as to include within the tonnage the entire closed-in capacity of vessels might be relatively permanent. They would possibly require less frequent change than would be necessary in the case of rules for the determination of net tonnage. Changes in the design of vessels, however, might require amendments in the rules as to what spaces shall be exempted from measurement and what spaces included within gross tonnage.

When tested by the last four of the nine requirements, enumerated above, that must be met by a satisfactory basis for Panama Canal tolls upon vessels of commerce, it is found that net tonnage is so much preferable to gross tonnage as to make the adoption of net tonnage imperative.

6. It is necessary that the Panama tolls be levied without discrimination against any important type of vessels. The basis of tolls should be such as to treat vessels of different classes equitably. For reasons that have been stated with sufficient detail in other parts of this report, it is clear that tolls based upon net tonnage, or the actual earning capacity, of vessels of commerce is the fairest as between different types of ships. Gross tonnage, like displacement, takes no account of differences in the construction of vessels and the use to which they are put in actual service. Tolls upon earning capacity take as full account of both these factors as it is practicable to take.

7. Tolls based upon net tonnage place no tax upon spaces set aside for the accommodation of the crew and for navigation purposes. It is true that the Suez Canal Co., by limiting deductions for spaces other than those occupied by propelling power to 5 per cent of the gross tonnage of the vessel, may not exempt all crew and navigation spaces. This 5 per cent limit of the Suez Canal Co. is, however, without justification. Rules for the determination of net tonnage should permit the deduction from gross tonnage of spaces actually devoted to the accommodation of the crew and of such spaces, reasonable in extent, as are needed for navigation pur-

poses. Tolls based upon the entire closed-in capacity of the ship are an inducement to builders and owners of ships to restrict crew spaces to a minimum.

8. Panama tolls upon gross tonnage would be so much more favorable to slow steamers with low engine power, as compared with faster and better types of ships, as possibly to dissuade steamship companies from introducing into their services through the canal the best type of ships at as early a date as they would introduce such vessels were the measurement rules such as to treat ships of all classes with equal fairness. It is, of course, desirable that the Panama Canal shall always be used by the most modern types of vessels.

9. The fact that light dues, tonnage taxes, and all charges, except for pilotage, now paid by vessels for the entry and use of ports, docks, and wharves, are based upon net tonnage is a strong reason for charging Panama tolls upon net rather than upon gross tonnage. In so far as it is possible without violating the general principle of basing Panama charges upon the earning capacity of vessels, it should be the policy of the United States to conform to the commercial practice of the world as regards charges upon shipping.

CONCLUSION.

Gross tonnage has only one point of superiority over net tonnage as a basis for Panama tolls and other charges, and that is the fact that gross tonnage may be determined somewhat more simply than net tonnage can be calculated. This, however, does not justify basing Panama tolls upon gross tonnage. Net rather than gross tonnage is to be recommended, because (1) tolls based upon gross tonnage would violate the fundamental principle that charges paid by vessels for the use of the canal should be based upon the earning capacity of ships; (2) gross tonnage fulfills none of the requirements and conditions that should be met in formulating rules to determine the tonnage upon which Panama tolls are to be paid more fully than those conditions are met by net tonnage; while (3) gross tonnage fails to meet satisfactorily at least four important tests that are met by net tonnage.

CHAPTER VIII.

THE NECESSITY FOR SPECIAL PANAMA MEASUREMENT RULES.

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One question to be decided in recommending rules for the measurement of vessels for the Panama Canal is whether to select one of the sets of rules now in force—the American, the British, or the Suez rules—or to formulate a special code of rules to determine the tonnage upon which the Panama tolls shall be paid. If it were practicable to select for Panama the American, the British, or the Suez measurement rules, it would be desirable to do so. The shipping of the world is already subject to an unfortunately large number of measurements, and the unification of existing rules rather than an increase in their number is needed. If a special measurement code is adopted for Panama, the reasons should be clear and conclusive, and consideration should also be given to the effect which a special set of Panama rules may have upon the ultimate unification of all measurement and tonnage rules.

GENERAL REASONS FOR HAVING A SPECIAL SET OF PANAMA MEASUREMENT RULES.

In the preceding chapter and elsewhere in this report, attention has been called to the fact that the necessity of treating the vessels of all nations with entire equality requires the application of the same measurement and tonnage rules to all merchant vessels using the Panama Canal. It has also been pointed out that the dissimilarity in the measurement and tonnage laws of different countries precludes the levying of Panama Canal tolls upon the tonnage of vessels as stated in their certificates of national registry. The lack of uniformity in the measurement rules and practices of different countries would, if tolls were paid upon the tonnage stated in certificates of registry, cause the United States to violate the provisions of the Hay-Pauncefote treaty, which stipulate that there shall be no discrimination among nations or their citizens or subjects in respect of the conditions of, or charges for, the use of the Panama Canal. There must not only be one set of rules for all vessels, but the rules must be such as to be fair as between countries and as between ships of different types.

It has been decided that Panama tolls shall be levied upon net tonnage and that the net tonnage upon which charges are paid shall accurately express the earning capacity of vessels. If any one of the existing sets of rules is to be adopted, a code must be found that provides for the measurement of vessels and the calculation of net tonnage in such a manner as to make the net tonnage closely approximate, if it does not exactly equal, the earning capacity of the vessel. The British, German, and American rules do not make net tonnage a close equivalent of earning capacity, and it is believed that the Suez rules would not be entirely satisfactory for Panama. The provisions of these various measurement rules have been so fully analyzed in Chapters IV and V that this chapter need only correlate and summarize the facts that make the adoption of any one of the existing measurement rules inadvisable.

The Suez Canal Co. levies tolls solely for the purpose of securing revenues. It has been the policy of the company to keep its tolls low enough to permit the growth of traffic. Moreover, the tolls and other charges are levied upon the earning capacity of vessels, the rates of charges being adjusted from time to time with the growth of traffic and revenue. As far as tolls and tonnage rules are concerned, the same general policy may wisely be followed by the United States Government in the management of the Panama Canal. In the long run a canal owned and operated by the Government may justifiably have lower tolls than a private corporation would charge if it owned the same waterway, but the proper basis for the charge would be the same whether the canal were owned by a Government or by a corporation, i. e., the charges, whatever they are, should be levied upon the earning capacity of the vessels served by the waterway.

The analysis that has been given in previous chapters of the measurement rules of Great Britain, Germany, and the United States shows that none of these national rules meets the requirement that net tonnage shall be the equivalent of actual earning capacity; indeed, the national rules are purposely framed with a view to making net tonnage low—less than the equivalent of the available cargo and passenger capacity of vessels. The owners of British ships naturally favor low net tonnage for vessels under the British flag. Nearly half of the shipping engaged in international trade is of British registry. These ships are required to pay, on the basis of their net tonnage, light dues or tonnage taxes and charges for wharfage, dockage, and, usually, for towing, not only in British ports but in foreign ports the world over. Ordinarily, a vessel having low net tonnage will have less to pay as port charges of various kinds than would have to be paid if the vessel's official net tonnage were higher.

In order to compete with Great Britain on equal terms, Germany and some other countries have framed or interpreted their laws for the measurement of vessels in such a way as to make the net tonnage of their ships practically equal to the tonnage which the same vessels would have if registered in Great Britain. The measurement laws of different countries are unlike in many particulars and the practice of admeasurers is not uniform, but the policy of Great Britain has a large influence upon measurement practice. The result of this is that in Germany, and in the case of most countries, net tonnage as stated in certificates of registry does not include all of the actual earning capacity of vessels.

The United States Government is under less incentive to make net tonnage low than are foreign shipowners or the shipping authorities of foreign countries, for the reason that most of the shipping under the American flag is engaged in the coastwise trade and has no tonnage taxes to pay. A comparatively small tonnage of American shipping is engaged in the over-sea international trade. Nevertheless, net tonnage, American registry, fails to include all of the space available for cargo and passengers. The deductions for propelling power is, by the American regulations, made in accordance with the percentage rule, 32 per cent being allowed for engine and fuel space in the case of screw-driven vessels whose engine-room space comes between 13 and 20 per cent of the gross tonnage of the vessel. Most freight steamers have engine rooms occupying only a little over 13 per cent of gross tonnage, and the propelling-power deduction is frequently from 6 to 9 per cent of the gross tonnage in excess of the percentage of gross tonnage that would be deducted if the allowance were equal only to the actual space occupied by the machinery and fuel. Moreover, the American measurement rules, as has been pointed out, contain a provision that should long since have been repealed, exempting from measurement, in the case of passenger ships, all tiers of superstructures except the lowest. This provision excludes from gross and net tonnage the large spaces included in the second and third tiers of superstructures regularly found upon the large transoceanic passenger steamers.

Although the owners of vessels will always desire measurement rules that make net tonnage as low as possible, and although Governments desirous of promoting the development of the merchant marine under their respective flags may deem it wise to keep the registered tonnage of national shipping lower than it would be if it accurately expressed the capacity of vessels for the transportation of passengers and cargo, there are no special reasons why the Panama measurement rules should make net tonnage less than the actual earning capacity of the vessels measured. The charges imposed upon ships that use the canal and the revenue derived by the Government from the management of the canal will be influenced both by the rules followed in determining tonnage upon which tolls are paid and by the rate of tolls charged. Of these two factors the measurement rules should be the constant and the rate of tolls the variable. Net tonnage should be an accurate expression of the earning capacity of vessels. The rate of tolls can be made as high or as low as may be deemed wise, and the rate of charges can be, and ought to be, changed from time to time with reference to the growth of traffic and revenue. If it be desired to try to promote the commerce of the world by keeping the canal revenues at a low figure, it will be necessary merely to adjust the rate of tolls accordingly. The tonnage upon which the charges are imposed can be kept equal to the earning capacity of vessels

Whatever tonnage rules are enforced at Panama, they must apply to all vessels using the canal, American as well as foreign. It would not be permissible, even if it were desirable, to have one set of rules giving ships under the flag of the United States a low net tonnage and another set of rules giving foreign vessels a higher tonnage. Its treaties and its traditions require the United States to treat the vessels of all nations with entire equality. Thus nothing is to be gained for the owners of American ships by making the tonnage of vessels upon which canal charges are levied less than the equivalent of the earning capacity of ships, nor would low net tonnage for all ships, American and foreign, at Panama in any way affect the charges payable by American-owned ships at foreign ports. The charges payable by vessels at the ports of the world are, with few exceptions, based upon the registered tonnage of the vessels.

OBJECTIONS TO ADOPTING THE BRITISH OR GERMAN MEASUREMENT RULES FOR THE PANAMA CANAL.

It is to be regretted that the British measurement rules are not such as to give the ships measured by those rules a net tonnage closely corresponding to the earning capacity of vessels. Nearly half of the shipping of the world engaged in international trade has British registry, and the measurement rules of Germany, and to a less extent of some other countries, are so interpreted by national admeasurers as to give vessels registered in Germany and elsewhere a net tonnage roughly corresponding to the tonnage vessels would have if registered in Great Britain. Because of international competition, the British precedent as to measurement has a large influence in other countries, but the rules of different countries are not uniform, and may be interpreted by national admeasurers with a view to lightening the burdens of the owners of ships. The lack of uniformity in international rules, the tendency on the part of national admeasurers to interpret rules in such a way as to aid the shipping of their particular countries, and, most of all, the fact that the British and other national measurement rules fail to make net tonnage an exact expression of the passenger and cargo capacity of vessels, are the general reasons which make necessary special Panama measurement rules.

The specific objections to adopting the present British or German measurement rules for the determination of the tonnage upon which Panama Canal tolls shall be paid may be stated in summary form as follows:

1. The British and German rules exempt from measurement large spaces under the so-called shelter deck—spaces which in actual practice are used regularly for the stowage of cargo. The shelter deck, it will be recalled, is the uppermost full-length deck provided with one or more "tonnage openings," which, while technically permanent openings, are in reality capable of being temporarily so closed as to keep out the sea. By no means all vessels have a shelter deck, but the large freight steamers for the transportation of general cargo are now usually of the shelter deck type. If the Panama rules were made the same as the British, as regards the treatment of shelter deck spaces, the vessels of different types would be treated unfairly and the United States Government would lose a part of the canal revenues to which it would be justly entitled.

2. The British, and likewise the German, measurement rules may cause admeasurers to exempt relatively large spaces in inclosed superstructures—spaces available for cargo or passengers—because of the lenient or loose interpretation given to the phrase "permanent closed-in spaces on the upper deck available for cargo or stores, or for the berthing or accommodation of passengers or crew." British and German admeasurers may exempt large bridge spaces which under the American and Suez rules are properly regarded as closed-in. These different definitions of closed-in spaces result in discriminations among vessels of different types and make the net tonnage of registry less than real net tonnage. The British and German practice, past as well as present, regarding the exemption of spaces under shelter decks and within superstructures generally is fully discussed in Chapter XI.

3. The Board of Trade percentage rule regarding deductions for propelling-power and fuel spaces, the rule which is applied in Great Britain, Germany, and also in the United States, discriminates largely in favor of vessels of low speed and power, and also deducts from gross

tonnage more space than is actually occupied by machinery and fuel. This percentage rule makes net tonnage for the majority of vessels appreciably less than their earning capacity. In Chapter IX will be found a full discussion of the origin of the percentage rule, of the efforts that have been made by the British Board of Trade to change the rule, and of the reasons why it is not deemed advisable to apply this rule at Panama.

4. The measurement rules of Great Britain and Germany, as applied to most ships, exempt large spaces that should be included in measurement, and thus make gross as well as net tonnage unduly low. The tolls at Panama are to be based upon net tonnage, but it is none the less important that the measurement rules should be such as to include in gross tonnage the entire closed-in capacity of the vessel. Spaces exempted from gross tonnage are thereby excluded from net tonnage, and unless gross tonnage includes the entire closed-in capacity of vessels, the net tonnage is almost sure to be an incorrect expression of earning capacity. The British and German rules are such as to exclude from gross tonnage not only spaces under a "shelter deck" fitted with a "tonnage opening" and spaces within superstructures provided with openings which make the spaces inclosed come within the technical definition of "open spaces," but the British and German rules also exempt numerous structures above the upper deck used for the navigation of the ship. The logical procedure, and the only one by which an accurate net tonnage can be calculated, is to include in gross tonnage the entire closed-in capacity of a vessel and to deduct therefrom, in calculating net tonnage, such navigation and other spaces as are not available for the accommodation of passengers or for the stowage of cargo.

5. The measurement rules of Germany exempt deck cargo from measurement, and thus exclude from the net tonnage upon which vessels pay charges large spaces used for carrying cargo and for earning freight revenue. Under the rules of Great Britain, deck loads are measured and the tonnage of the space occupied by deck cargo is added to the tonnage upon which light dues are paid. The objection to the British practice, however, is that cargo carried under a so-called "shelter deck" provided with a "tonnage opening" is treated as deck cargo and only such portion of the entire space under the "shelter deck" is measured as is actually occupied by the "deck" cargo. The practice of treating as deck loads the cargo carried under the "shelter deck" goes far to explain why the measurement rules of Great Britain are not so amended as to include within gross and net tonnage the spaces under the "shelter deck"—spaces which are quite regularly used for the stowage of dry as well as "wet" cargo.

OBJECTIONS TO ADOPTING THE EXISTING AMERICAN MEASUREMENT RULES FOR THE PANAMA CANAL.

The measurement rules of the United States give freight vessels and some passenger ships of American registry a larger gross and net tonnage than the same vessels would ordinarily have if registered in Great Britain or Germany, but the net tonnage of American vessels is in many cases less than the actual cargo and passenger capacity of the ship; and the rules are such as to discriminate largely between different types of vessels. The reasons why it would not be advisable to determine the tonnage upon which Panama tolls shall be paid by applying the American rules to the measurement of vessels using the canal may be briefly summarized as follows:

1. The provisions of the American rules which exempt from measurement the portions of a ship "used for cabins or staterooms and constructed entirely above the first deck, which is not a deck to the hull," would, if applied at Panama, unjustifiably exclude from the tonnage upon which tolls are paid relatively large spaces upon most steamers having passenger accommodations. Passenger steamers with more than one tier of passenger accommodations would be unduly favored as compared with other passenger vessels and with freight steamers. The exemption from measurement of the cabins and staterooms in the superstructures above the first tier is a defect in our tonnage rules that ought to be cured by the amendment of our navigation laws. The inclusion of such a provision in the Panama measurement rules would be inexcusable.

2. The deductions for propelling-power and fuel spaces under the American rules have, since 1895, been practically the same as the deductions made in Great Britain and Germany. The Board of Trade percentage rule is followed, and the deductions made thereby cause the net tonnage of most vessels to be less than their earning capacity.

3. The gross tonnage of vessels, as determined by the American rules, does not include the entire closed-in capacity of vessels, because of the exemption of cabins and staterooms situated "above the first deck which is not a deck to the hull," and because of the exemption from measurement of various navigation spaces located above the upper deck. The navigation spaces exempted under the American rules are designated and described in Chapters IV and XI.

4. The American rules exempt deck loads from measurement. In certain kinds of coastwise traffic the owners of vessels are tempted to put such large deck loads upon vessels as to endanger the safety of the ship and thus to place the lives of the crew in peril. To exempt the space occupied by deck cargo from the payment of Panama tolls would further strengthen the tendency to make vessels top-heavy. Deck cargoes need to be regulated by law, and there are special reasons why the spaces occupied by such cargo should not be exempted from canal tolls and other charges payable by vessels.

SPECIAL LEGAL AND POLITICAL REASONS AGAINST ADOPTING ANY ONE OF THE CODES OF NATIONAL MEASUREMENT RULES FOR THE PANAMA CANAL.

In addition to the above-mentioned specific objections to the adoption of the British, German, or American rules for the measurement of vessels to determine the tonnage upon which Panama tolls shall be paid, there is a legal reason calling for the adoption of special Panama measurement rules. The President's proclamation of November 13, 1912, provides that the tolls on merchant ships shall be "$1.20 per net vessel ton—each 100 cubic feet—of actual earning capacity"; and the Hay-Pauncefote treaty further provides "that there shall be no discrimination against any nation or its citizens or subjects." The President's proclamation makes it necessary that the Panama rules shall be such as to cause the tolls to be paid upon "actual earning capacity"; and the treaty, by prohibiting any discriminations against the citizens or subjects of any nation, practically prohibits unfair discriminations as between the owners of different types of vessels.

Of course it will be understood that the United States could not adopt for the measurement of vessels using the Panama Canal the national rules as such of Great Britain or any other foreign country and accept for the payment of Panama tolls the tonnage stated in British or other national registry certificates. If the United States were to adopt the British rules for Panama, they might not long remain the same as the existing British rules. The present British measurement laws first enacted in 1854 were amended in 1867, 1876, 1889, 1906, and 1907. In order to keep the Panama rules and those of Great Britain identical, it would probably be necessary for the United States from time to time to adopt the changes made by Great Britain in her rules. If the United States were to adopt the definite policy of keeping the Panama measurement rules the same as those prevailing in Great Britain, the United States would thereby give Great Britain an indirect control over the Panama Canal revenues. Naturally, the United States would not care to adopt such a policy.

REASONS AGAINST MAKING THE PANAMA MEASUREMENT RULES THE SAME AS THE SUEZ RULES.

While there would be strong and controlling reasons against adopting for the measurement of vessels using the Panama Canal either the British, German, or American rules, there would be much less objection to making the Panama rules practically the same as those of the Suez Canal Co. The adoption of the Suez rules at Panama and the acceptance of Suez tonnage certificates at Panama and of Panama certificates at the Suez Canal, would be of advantage to commerce, and, if practicable, the tonnage rules of the Suez and Panama Canals ought, ultimately if not immediately, to be made identical. It would seem that the Suez and Panama measurement rules might, without great difficulty, be made substantially the same, and the great desideratum of international unity in vessel measurement and tonnage be thus brought

nearer realization. The Suez and Panama rules are certain to have the following points in common:

1. The Suez rules are applied to vessels to determine the tonnage upon which tolls shall be paid for the use of an interoceanic canal whose services to the world's commerce are similar to those that will be performed by the Panama Canal. Measurement and tonnage rules that experience has proven to be satisfactory at Suez ought to prove satisfactory at Panama. The fact that the Suez Canal is owned and operated by a corporation and that the Panama Canal will be a Government enterprise will not necessarily affect the principles that should control in the formulation of rules for the determination of the tonnage upon which charges shall be imposed.

2. The Suez rules are applied to the measurement of vessels solely to determine a tonnage that may equitably be made the basis of charges for the use of the canal. Unlike the several national rules for the measurement of vessels, those of the Suez Canal Co. are not, and naturally would not be, formulated with a view to promoting the shipping of any one nation or to favor any particular class of vessels. The Suez Canal Co. would have the same reasons for basing its measurement rules upon accurate principles as the United States would have in deciding upon the regulations to be followed in determining the tonnage upon which Panama charges shall be levied.

3. The Suez Canal toll is levied upon the "ton of capacity" as defined in 1873 by the International Tonnage Commission that met in Constantinople. This body, made up of delegates from the leading commercial nations of Europe, formulated the Suez Canal Co.'s measurement rules with a view to making gross tonnage, as determined by those rules, approximate the closed-in capacity of vessels, and net tonnage the capacity available for the accommodation of passengers and the stowage of cargo. The Suez rules include within gross tonnage several spaces which the national rules improperly exempt from measurement, and, with few exceptions, the Suez rules exempt only such spaces as are not actually inclosed. Moreover, the Suez rules, as is fully explained in Chapters IX and XI, are more accurate than any of the national rules as regards deductions made from gross tonnage to determine net tonnage.

The largest single deduction made from gross tonnage is the space allowed for propelling power and fuel and as regards this deduction, the Suez rules are much more accurate than the percentage rule, the one followed in Great Britain, Germany, and the United States. The Suez regulations, as has been explained, give the owners of many vessels—ships that have fixed coal bunkers—the choice between having the propelling-power deductions made according to the German or actual-measurement rule or according to the Danube rule, which, in the case of screw-propelled vessels provides for a total propelling-power deduction of a space equal to one and three-fourths the space occupied by the engine room. In Chapter IX the objections to the percentage rule for propelling-power deductions are discussed at length.

However, the Suez rules, though based upon sound principles, do not fully realize the ideal of making gross tonnage the equivalent of the entire closed-in capacity and of making net tonnage synonymous with actual earning capacity. Some compromises were necessary in the formulation of rules framed by a commission composed of delegates representing rival commercial nations, and the practices then prevailing, especially in Great Britain, as to exemptions and deductions of particular spaces within vessels, naturally influenced the provisions of the rules as adopted.

Moreover, the steamship companies and navigation interests affected by the Suez rules have from time to time sought to bring about the amendment of the rules in such a way as to reduce the tonnage upon which tolls are paid. The amendments made to the rules by the canal company in 1904 were brought about by the interested navigation companies.

The provisions of the Suez measurement rules, as they were formulated in 1873 and as the rules are to-day after amendment, are fully analyzed and explained in other portions of this report. It is sufficient in this connection to say that the Suez rules as they stand to-day are not entirely logical. They fail, in several particulars, to observe the fundamental principles upon which the rules as a whole are based, and it would not be advisable to adopt, without

certain relatively important changes, the present Suez rules for the measurement of vessels to determine the tonnage upon which Panama tolls shall be paid.

The gross-tonnage rules of the Suez Canal Co., while providing for the measurement of the gross capacity of vessels more completely than do any of the several national rules, are open to criticism as regards the following particulars:

1. The Suez rules, as amended in 1904, exempt from measurement the poop up to one-tenth of the length of the vessel and the forecastle up to one-eighth of the vessel's length (see Chap. IV, p. 53), provided the spaces in the poop and forecastle are considered "open" by the measurement rules of the country in which the vessel is registered. The general principles of the Suez rules would provide for the measurement of the entire space within poop and forecastle, and it was, up to 1904, the practice of the company to include the entire poop and forecastle spaces of all vessels in gross tonnage. The concession made in 1904 is objectionable because it exempts from measurement spaces which may, in fact, be available for cargo, supplies, passengers, or crew. The rule of 1904 is also to be criticized because it makes the Suez Canal tonnage dependent to some extent upon national measurement rules. In the formulation and application of measurement rules, the principle should be adhered to of including all closed-in spaces within gross tonnage.

2. The Suez rules always exempt double bottom spaces from measurement. Double bottom spaces should be exempted when they are used or can be used only for water ballast, but the double bottom compartments that are or may be used to carry fuel or anything other than water ballast should be measured and included in gross tonnage. Double bottom spaces used for fuel oil, feed water, or cargo are a part of a vessel's usable contents, and the several national registry rules properly provide for the measurement of such spaces.

3. A third minor objection to the Suez gross tonnage rules is that, as amended in 1904, they do not provide for the exemption under all circumstances of the spaces within the light and air casings and the spaces framed in around the smoke funnels to the extent that such spaces are located above the first tier of erections above the upper deck or an inclosed "shelter" deck with "tonnage openings." The spaces above the first tier of erections within the light and air casings and within the casings surrounding the smoke funnels form no real part of a vessel's closed-in capacity. It has long been the practice in Great Britain, Germany, and the United States to include within the engine room light and air and funnel spaces above the upper deck, or a portion of such spaces, when necessary to make the engine-room space more than 13 per cent of the entire space included in gross tonnage. The privilege thus given shipowners has resulted in the manipulation or juggling of engine-room space for the purpose of securing maximum deductions for propelling power. The amendments which the Suez Canal Co. made in its rules in 1904 permit a similar practice in the case of vessels measured under the Suez rules. It would have been better for the Suez Canal Co. not to have made this change in its rules. (See Chap. XI, p. 176.)

The net tonnage of vessels measured by the Suez rules is more nearly equivalent to the earning capacity of vessels than is the net tonnage as determined by any of the national rules; but, in the following particulars, the Suez rules fail to adhere to the tonnage principles which were adopted by the International Tonnage Commission of 1873, and which it is recommended should be adhered to in the formulation and administration of the Panama measurement rules:

1. The Suez rules arbitrarily limit to 5 per cent of the gross tonnage the total deductions that may be made for crew spaces and for all spaces other than those occupied by machinery and fuel. This 5 per cent limit should not be included in the Panama measurement rules, because it puts a premium upon limiting crew spaces to the legal minimum. The Panama measurement rules should permit the actual spaces occupied by the crew to be deducted from gross tonnage.

2. The Suez rules deduct from gross tonnage the spaces used for the working and navigation of the ship only when those spaces are located above decks. This is not correct in principle. Whenever such spaces are not available for passengers or cargo they should be deducted from gross tonnage whether located above or below deck. They are obviously not a part of the vessel's net capacity.

3. The Suez rules do not deduct water-ballast tanks, such as side or peak tanks. When such tanks are not available for stowing oil or cargo they should be deducted from gross tonnage as is provided for in the various national measurement rules. Tanks that can be used solely for carrying ballast are not a part of a vessel's net capacity.

4. The room or rooms occupied by boatswain's stores are not deducted under the Suez rules, which thereby include in net tonnage certain spaces not available for the stowage of cargo or for the accommodation of passengers.

5. Probably for the reason that the Suez Canal is not used by sailing vessels, the Suez measurement rules do not provide for the deduction of spaces used for the stowing of sails on sailing vessels. Ordinary sailing vessels will not use the Panama Canal, but in all probability the canal will be used by a considerable number of large sailing vessels equipped with auxiliary engines. Such vessels are now used to some extent. The Panama rules should allow deductions to be made of spaces occupied by sails upon sailing vessels. The national measurement rules provide for the deduction of the actual space set aside for the stowage of sails upon vessels propelled solely by sails up to a maximum of $2\frac{1}{2}$ per cent of the gross tonnage. The Panama rules may well allow the deduction of the space occupied by sails up to $2\frac{1}{2}$ per cent of the gross tonnage, in the case of vessels propelled wholly by sails.

6. The Suez rules exempt from measurement and from the payment of canal tolls spaces occupied by deck loads. For reasons stated above the spaces occupied by lumber and other freight carried on open decks should be regarded as a part of a vessel's earning capacity, and the volume of such space should be added to the tonnage upon which tolls and other canal charges are paid. It should not be the policy of the United States to offer a premium upon deck cargo by exempting from tonnage and tolls the spaces occupied by such cargo.

CONCLUSION.

The analysis of the measurement rules of Great Britain, Germany, and the United States (and, also, of the French rules in Appendices VIII and IX) shows that the gross tonnage and net tonnage of vessels, as determined by the navigation laws of the leading commercial nations, do not accurately express the closed-in capacity and the net, or earning, capacity of vessels. Great Britain and, because of her action, other countries have purposely sacrificed accuracy in order to make tonnage low, and thus to lighten the port and other charges paid by shipping. The Suez rules are based upon sound principles and would be more satisfactory than would any of the national rules for determination of the tonnage upon which Panama tolls shall be paid. If the Suez Canal Co. should find it possible and advisable to bring about the modification of their measurement rules as to correct the defects noted in this chapter—and most of the changes required would affect provisions of relatively minor importance—the Panama and Suez rules can doubtless be made identical, and a long step can be taken toward the goal of complete international unification of tonnage and measurement rules; but unless, or until, the Suez rules can be so modified that gross tonnage according to those rules will accurately express the entire closed-in space and net tonnage the net, or earning, capacity of vessels, it will be well to have different rules for the measurement of vessels to ascertain the tonnage upon which Panama tolls shall be paid.

The Panama measurement rules should be based on correct principles and the several provisions of the rules should be made to accord as closely as possible with those principles. The Panama rules should be accurate to start with and should be permanent, except for such minor changes as may be required on account of the introduction of new types of vessels or new kinds of engines. It is possible that, by making the Panama rules correct in principle and in detail, they may, because of their accuracy, help bring about greater unity in measurement rules and practice.

CHAPTER IX.

DEDUCTIONS FOR PROPELLING POWER; HISTORY AND CRITICISM OF RULES.

CHAPTER IX.

DEDUCTIONS FOR PROPELLING POWER, HISTORY AND CRITICISM OF RULES.

I. Introduction.

The rules recommended for the determination of the net tonnage upon which Panama Canal tolls payable by vessels of commerce shall be levied provide that the deduction from gross tonnage to allow for the space occupied by propelling power—machinery and fuel—shall be made according to the Suez rule, to which reference has been made in earlier chapters of this report. This is not the rule by which propelling-power deductions are made in the United States, Great Britain, and Germany to determine the net registered tonnage of vessels, but is a part of the Suez Canal Co.'s present regulations. It was formulated for the Suez Canal Co. by the International Tonnage Commission which met in Constantinople in 1873.

The decision in favor of incorporating in the Panama measurement rules the Suez rule regarding propelling-power deductions has been reached after a careful consideration of the principles involved. The so-called percentage rule by which propelling-power deductions are made by most countries, when vessels are measured to determine their registry tonnage, originated in Great Britain. The history of the origin of the percentage rule and of its practical working in Great Britain and other countries that have followed the precedent established by Great Britain has also strengthened the conviction that the Suez instead of the percentage rule regarding propelling-power deductions should be incorporated in the rules applied to vessels to determine the tonnage upon which Panama Canal tolls shall be paid.

The most important provision of any code of tonnage rules is the one governing deductions made to allow for the space occupied by machinery and fuel. The propelling-power deductions include from three-fourths to five-sixths of the total reduction made from gross to determine net tonnage. In Great Britain, the deductions now made for crew and navigation spaces (all allowances other than for propelling power and fuel) amount to 4½ to 12 per cent of the gross tonnage of merchant steamers. The total deductions from gross tonnage, including those for propelling power, crew spaces, and navigation purposes, average 39 per cent for the entire British merchant fleet. The Suez Canal Co. limits deductions, other than for propelling power and fuel, to 5 per cent of the gross tonnage, and this same rule is adhered to by Austria-Hungary, Italy, Sweden, and Greece. Japan allows maximum deductions other than for propelling power and fuel amounting to 6 per cent of the gross tonnage. It is thus evident that the amount of tolls paid by the owners of vessels for the use of the canal and the revenues received by the United States Government in the operation of the canal may be appreciably affected by the rule governing propelling-power deductions. It is important that those deductions should be fair to the owners of ships and to the owners of the canal.

The three methods by which propelling-power deductions are determined were explained in Chapter V. Those methods or rules are as follows:

1. The percentage method, which provides for a deduction of 32 per cent of the gross tonnage of screw-propelled steamers, the actual volume of whose engine room is above 13 and under 20 per cent of the space included in gross tonnage, and for a deduction of 37 per cent of the gross tonnage of paddle-wheel steamers, the actual volume of whose engine room is above 20 and under 30 per cent of the space included in gross tonnage.

2. The so-called Danube rule, which provides for the deduction of the actual volume of the engine room increased by ¾ in the case of screw steamers and of the actual volume of the engine room increased by ½ in the case of paddle-wheel vessels.

3. The actual measurement or so-called German rule, which provides for the deduction of the space actually occupied by the engine room and by fixed bunkers or oil compartments.

Engine rooms or machinery spaces as used in all the above rules include the spaces actually occupied by and necessary for the operation of the engines and boilers; also the space occupied by the shaft tunnel and the spaces above the engine and boiler rooms required for the admission of light and air. As has been explained, however, the rules are not uniform as to the portion of the total light and air and funnel spaces that shall be included within engine and boiler rooms.

But few countries apply to all steamships any one of the above methods of determining the deductions that shall be made for propelling power. Austria-Hungary, Sweden, and Belgium adhere to the third rule and allow for propelling power the space actually occupied by machinery and fuel. The more general practice is to make propelling-power deductions according to the British tonnage rules, which provide for deductions of 32 per cent and 37 per cent in the case of steamers which come within the percentage limits above stated. The British tonnage rules provide that, in the case of screw-propelling steamers whose engine and boiler rooms occupy 13 per cent or less, or 20 per cent or more, of the space included in gross tonnage, the deductions for propelling power shall be made either in accordance with the percentage rule or the Danube rule, as may be determined by the Board of Trade and the owners of vessels. The practice is to make the deductions according to the Danube rule when the engine and boiler rooms occupy 13 per cent or less of the entire space, and, also, according to the Danube rule when the machinery spaces amount to 20 per cent or more of the gross tonnage. The British rule regarding paddle-wheel steamers is the same as that concerning screw-propelled vessels, except the Danube rule is applied to paddle-wheel steamers whose engine and boiler rooms occupy 20 per cent or less, or 30 per cent or more, of the space included in gross tonnage. The American rules do not give vessel owners the option of the Danube or percentage rule; when the space occupied by the engine room is 13 per cent or less (for paddle-wheel steamers, 20 per cent or less) of the space included in gross tonnage, the deduction must be made by the Danube rule. The American rules, like those of Great Britain, give the shipowner the option of the Danube or percentage rule when the engine-room space exceeds the 20 or 30 per cent limits. Germany, France, Denmark, Italy, the Netherlands, Norway, Russia, Japan, and Spain follow the British practice.

The Suez regulations (and also the registry laws of Greece) as to propelling-power deductions combine the Danube and actual-measurement rules. The propelling-power deductions in the case of vessels with fixed bunkers may, if the owners of the vessels prefer, be the space actually occupied by machinery and fuel.

The Suez Canal Co. and some countries limit propelling power deductions to a fixed maximum percentage of gross tonnage. The Suez regulations (and also those of the Danube Commission, of Denmark, Sweden, Greece, and of Austria-Hungary) limit the deductions to 50 per cent of the gross tonnage. The tonnage laws of Great Britain as amended in 1907 provide that propelling power deductions shall not exceed 55 per cent of the gross tonnage remaining after crew and navigation spaces have been deducted. The measurement rules of the United States, Germany, and France fix no maximum limit to deductions for propelling power.

In the preceding chapters emphasis has been placed upon the necessity of adhering to the two general principles that gross tonnage should include the entire closed-in volume of vessels and that net tonnage should accurately express earning capacity—the space available for accommodating passengers and stowing cargo. If net tonnage is to be an accurate expression of passenger and cargo capacity, the deductions for propelling power must at least approximate the space occupied by machinery and fuel. Ships vary so greatly in design and service as to complicate the problem of formulating a general rule for propelling power deductions that will be correct in principle and will apply with fairness to vessels which are equipped with very different types of engines.

It is usually wise to act in the present and for the future with reference to what the past has taught. The percentage rule for making propelling power deductions has been followed by Great Britain since 1854. The Suez Co.'s rule for determining those deductions has been

applied by the company since 1874, the rule having been adopted by an international tonnage commission. Which rule, in the light of experience, shall be followed in calculating the tonnage upon which Panama tolls shall be paid? It is the purpose of this chapter to answer that question.

II. The British Board of Trade Rule Concerning Propelling Power Deductions.

The British Merchant Shipping Act of 1854, in which the so-called Board of Trade rule governing propelling power deductions first made its appearance, was preceded by the acts of 1819 and 1836, each of which provided a method for determining the deductions to be made from gross tonnage to allow for the space occupied by machinery and fuel. The act of 1819 (59 George III, chap. 5) provided that the vessel's length for tonnage computations should be considered to be the difference between the length of the engine room and the entire length of the keel. This seems like providing for a very liberal deduction for propelling power, but it should be remembered that vessels of that date usually had but two or three decks, and it is possible that this method of determining engine-room space, though crude, may have been roughly accurate. It was soon, however, considered unsatisfactory and the "new measurement" law of 1836 provided that the actual space occupied by the engine room as calculated by a prescribed formula should be deducted from the space included in gross tonnage. The act of 1836 provided that the volume of the engine room should be determined by multiplying its length, in feet, between its foremost and aftermost bulkheads by the depth of the vessel below the upper deck at amidships, by the inside breadth of the ship at the midship division, and by dividing the product of these three dimensions by 92.4. This formula for determining the divisions for propelling power included in those deductions only the side bunkers. Any bunkers forward of the forward bulkhead or aft of the rear bulkhead of the engine room were not included in the deductions. Transverse bunkers were, however, probably not a regular part of vessels as they now are. The rule of 1836 seemed to provide for the deduction from gross tonnage of the entire underdeck space, between the forward and after bulkheads bounding the engine and boiler rooms, and this led to the construction of some vessels with engine and boiler rooms separate from each other. The space between the two rooms was not used for machinery or fuel, but was included in the deductions for propelling power.

In 1849 a royal commission on tonnage was appointed to report upon the entire subject of measurement rules and tonnage. This commission reported the following year in favor of determining the closed-in capacity of vessels and also the space taken up by machinery and fuel by a system of external measurements. It was thus recommended that the long-established principle of determining the cubical contents of vessels by internal measurement should be superseded by rules for measuring vessels externally. This would have been a step backward, and fortunately Parliament did not not adopt the recommendation of the royal commission. It is worthy of note that this commission was doubtful as to the advisability of making any deduction from gross tonnage to allow for the space occupied by propelling power. The commission was evidently influenced by the contention of the sailing-vessel owners that the steamship might prove a dangerous competitor of the sailing vessel. In determining the net tonnage of sailing vessels, but small deductions were made from gross tonnage, and it was contended that the deductions for propelling power gave steamers an undue advantage over sailing vessels.

The secretary of the Royal Commission of 1849–50 was Mr. George Moorsom.[1] Parliament having wisely declined, in 1850, to adopt the recommendation of the Royal Commission providing for the external measurement of vessels, Mr. Moorson worked out what has ever since been known as the Moorsom system of measuring the contents of spaces in vessels. The Moorsom rules for determining the closed-in capacity of vessels were incorporated in the Merchant Shipping Act of 1854, and since then they have become a part of the measurement rules of all countries and of the Suez Canal Co.

[1] Mr. Moorsom was a member of the Royal School of Naval Architecture, honorary secretary of the Royal Commission of 1849, surveyor general of tonnage for 10 years, member of Special Committee on Tonnage of the British Association for Advancement of Science in 1857, author of a book on tonnage, and the originator of Moorsom's system of measurement.

Moorsom's method of measuring the closed-in capacity of vessels was incorporated in the act of 1854, but his recommendation as to deductions for propelling power was not adopted and did not become a part of the law. Mr. Moorsom was in favor of continuing to make propelling-power deductions according to the method provided for by the act of 1836 with certain amendments and improvements calculated to provide for a more exact measurement of the spaces actually occupied by machinery and fuel. Instead of accepting Mr. Moorsom's recommendation in this regard, an entirely new rule, formulated by Admiral Beachey, nautical adviser to the Board of Trade, was made a part of the act of 1854. The only change that has since been made in the rule as adopted in 1854 has been to substitute "Board of Trade" for "Commissioners of Customs," a change that was made necessary in 1872 when the Board of Trade was intrusted with the measurement and registry of vessels. The rule adopted in 1854 was as follows:

As regards ships propelled by paddle wheels in which the tonnage of the space solely occupied by and necessary for the proper working of the boilers and machinery is above 20 per cent and under 30 per cent of the gross tonnage of ship, such deduction shall be 0.37 of such gross tonnage, and in ships propelled by screws, in which the tonnage of such space is above 13 per cent and under 20 per cent of such gross tonnage, such deduction shall be 0.32 of such gross tonnage.

As regards all other ships, the deduction shall, if the Commissioners of Customs and the owner both agree thereto, be estimated in the same manner; but either they or he may, in their or his discretion, require the space to be measured and the deduction estimated accordingly; and whenever such measurement is so required the deduction shall consist of the tonnage of the space actually occupied by or required to be inclosed for the proper working of the boilers and machinery, with the addition in the case of ships propelled by paddle wheels of one-half, and in the case of ships propelled by screws of three-fourths of the tonnage of such space.

Mr. Moorsom's objection to the percentage rule for determining propelling power deductions is evidenced both by his long-continued efforts to have the law changed and by the testimony of officials of the Board of Trade who were familiar with the origin of the percentage rule. In 1874, Mr. Thomas H. Farrer, who was then permanent secretary of the Board of Trade, and who had been connected with the Board of Trade since 1850, testified before the Parliamentary select committee, to whom the merchant shipping bill then under consideration had been referred, that the rule for propelling power deduction contained in the act of 1854 was "forced upon Mr. Moorsom," who "from the beginning was as discontented with the working of that rule as he had been with it in its inception.[1]

Similar testimony was submitted to the Royal Commission on Tonnage of 1881 by Mr. Thomas Gray, assistant secretary of the Board of Trade, who stated that Mr. Moorsom "who knew more about tonnage than anybody living * * * was always violently opposed to the allowance for engine room in steamships contained in the act of 1854. It was done against his advice altogether. It was settled by Admiral Beachey and the steamship owners, much to the chagrin of Mr. Moorsom." [2]

The percentage rule for propelling power deduction which was incorporated in the Merchant Shipping Act of 1854 through the influence of the owners of steamships, was apparently intended to provide for the deduction of approximately the actual space occupied by machinery and permanent bunkers; but experience soon showed that the allowance for propelling power, under the percentage rule, was greater than the space occupied by the engine and by both fixed and movable bunkers. For many steamers the percentage rule operated as a bounty that assisted them in competing with sailing vessels, which for more than two decades after

[1] The following quotation from Mr. Farrer's testimony of 1874 is illuminating: "That space (space occupied by machinery and coal) was measured before 1854 by a very rough rule; it measured the section of the ship at the extremities of whatever space or spaces were occupied by the engine room, and then took the whole slice of the ship between those two sections; the consequence was extreme evasions of the law, so that a ship of nearly 2,000 tons would sometimes measure only 300 or 400, because, of course, if the engine rooms were placed as they were, in order to evade the law, at a little distance from one another, you might get almost the whole ship included in the section that was excepted on account of engine space. There was a great discussion in 1853 as to how this should be remedied; Mr. Moorsom himself always wished to retain the actual measurement of the engine room, but to amend it and make it more accurate; the then chief nautical adviser to the Board of Trade, Admiral Beachey, forced upon Mr. Moorsom a different plan, and I wish particularly to call attention to this, because something has been said about the employment of civilians in these matters; Mr. Moorsom was a civilian; he was a man who had given great attention to this subject; he was perfectly impartial upon it; he had a scientific interest in it, and all that he wished was to make as accurate a system as possible; the consequence of that was, that, taking his advice, we have, as regards gross tonnage, got a perfectly good rule, or at least so good a rule that all nations are adopting it, but Admiral Beachey, the sailor, forced upon Mr. Moorsom this plan of percentage deductions for engine room, of which the committee have heard so much, and into which I will not go. I will leave the inequalities and the injustices of that rule to be enforced by others. * * * To go on with the history of the engine room, I may say that Mr. Moorsom, from the beginning, was as discontented with the working of that rule as he had been with it in its inception; he perpetually called the attention of the Board of Trade to the extreme injustices and inequalities that were caused by it." (Report of Select Committee on Measurement of Tonnage of 1874, pp. 142-143.)

[2] Report of Royal Commission on Tonnage, 1881, p. 4.

the enactment of the Merchant Shipping Act of 1854 were the chief deep-sea carriers of heavy freight.[1]

The percentage rule being satisfactory neither to the Commissioners of Customs nor to the Board of Trade,[2] efforts were soon made to have the act of 1854 amended.

The initiative was taken by Mr. Moorsom, who from the start had the support of the Commissioners of Customs. In 1859 the Board of Trade invited the opinion of various bodies representing shipping, and in 1860 Mr. Moorsom, in a carefully prepared paper, urged the Board of Trade to return to the method of making propelling-power deductions that had been provided for in the act of 1836, and he suggested that if this should be impossible, that the so-called Danube rule should be applied to all steamers to determine propelling-power deductions.

No action having been taken by Parliament, the Commissioners of Customs and the Board of Trade decided to act upon the authority which they believed had been granted them by section 29 of the act of 1854, which provided that—

> The Commissioners of Customs (later changed to the Board of Trade) may, with the sanction of the Treasury, appoint such persons to superintend the survey and admeasurement of ships as they think fit; and may, with the approval of the Board of Trade, make such regulations for that purpose as may be necessary; and also, with the like approval, make such modifications and alterations as from time to time become necessary in the tonnage rules hereby prescribed, in order to the more accurate and uniform application thereof, and the effectual carrying out of the principle of admeasurement therein adopted.

Acting upon the theory that the foregoing grant of power to "make such modifications and alterations as from time to time become necessary in the tonnage rules" permitted them to change the rules for propelling-power deductions, the Board of Trade suspended the percentage rule and substituted for it the rule of 1836, as revised by Mr. Moorsom with a view to preventing the evasions and frauds that had been possible under the original rule of 1836. This rule, it will be remembered, provided for the deduction from gross tonnage of the entire underdeck space between the forward and aft bulkheads inclosing the engine and boiler rooms. Longitudinal coal bunkers between the bulkheads bounding the engine and boiler rooms were included in the space deducted, but athwartship coal bunkers were not deducted. Mr. Moorsom considered that the deduction of the space included in the below-deck section of the ship between forward and aft engine and boiler room bulkheads made a liberal allowance for propelling power.[3]

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[1] A large shipbuilder of West Hartlepool made the following statement in his testimony before the Royal Commission of 1881:

"Do you know at all what led to these allowances being made for steamers originally?" "Yes, I think it was to encourage the people of this country to invest their capital in steam. There is a very large amount of money buried in the engine room, perhaps one-third of the whole value of the ship."

"Do you still think that the steam shipping trade of this country requires encouragement?" "I think it does require encouragement, or if it does not require encouragement it ought not to be subjected to oppression in the face of bounties and other things that are creeping up. I believe the law is passed now that the French will subsidize their mercantile marine, and the Americans and Germans will follow without a doubt." (Royal Commission Report, 1881, p. 93.)

[2] The objections to the percentage rule for propelling power deductions contained in the act of 1854, and the extent to which the deductions favored steamships as compared with sailing vessels, were concisely summarized as follows in a book on rules for engine-room deductions published in 1867 by Mr. Thomas Gray, who was for many years an assistant secretary of the Board of Trade in charge of the marine department:

First. That the 1854 rules are unfair as between steamship and steamship;

Second. That therefore one steamship owner has to pay dues for another;

Third. That they offer a premium for certain peculiar forms of ships;

Fourth. That they are objected to by the sailing ship owner and the dock owner as unfairly reducing the registered tonnage of high-class ships;

Fifth. That under the act of 1854 the register tonnage of sailing ships was reduced 7 per cent on the tonnage of 1836, while the registered tonnage of steamships was reduced 14 per cent, or double the amount of reduction of sailing-ships; and

Sixth. That since a certain sum must be paid every year for dues, the sailing ship owner pays more than his share, and the steamship owner less.

[3] The rule of 1860 as issued by the Board of Trade was as follows:

"In every ship propelled by steam or other power requiring engine room, an allowance of space or tonnage shall be made for the space occupied by the propelling power, and the amount so allowed shall be deducted from the gross tonnage of the ship, ascertained as aforesaid, and the remainder shall be deemed to be the register tonnage of such ship; and such deduction shall be estimated as follows, that is to say:

"1. Measure the mean length of the engine room between the foremost and aftermost bulkheads or limits of its length, excluding such parts of the said length, if any, as are not actually occupied by or required for the proper working of the machinery; then measure the depth of the ship at the middle point of this length, from the ceiling at the limber strake to the upper deck in ships of three decks and under, and to the third deck, or deck above the tonnage deck, in all other ships; also the inside breadth of the ship clear of sponsing, if any, at the middle of the depth; multiply together these three dimensions of length, depth, and breadth for cubical contents; divide this product by 100, and the quotient shall be deemed to be the tonnage of the engine room, or allowance to be deducted from the gross tonnage on account of the propelling power.

"2. In the case of ships having more than three decks, the tonnage of the space or spaces betwixt decks, if any, above the third deck, which are framed in for the machinery, or for the admission of light and air, found by multiplying together the length, breadth, and depth thereof, and dividing the product by 100, shall be added to the tonnage of such space.

"3. In the case of screw steamers, the tonnage of the shaft trunk shall be deemed to form parts of and be added to such spaces, and shall be ascertained by multiplying together the mean length, breadth, and depth of the trunk, and dividing the product by 100.

"4. In any ship in which the machinery may be fitted in separate compartments, the tonnage of such compartment shall be measured, severally, in like manner according to the above rules, and the sum of their results shall be deemed to be the tonnage of the said space."

This rule governed propelling-power deductions from 1860 to 1866, when the City of Dublin Steam Packet Co. convinced the courts that the Board of Trade had exceeded its authority in promulgating the rule of 1860. In the case before the courts the merits of the 1854 and 1860 rules were not under consideration. The question was solely that of the power of the Board of Trade under the law. Following the decision of the courts in the City of Dublin Steam Packet Co. *v.* Thompson, in 1866, the percentage rule of the act of 1854 again became effective, and it has remained in force ever since.

The Board of Trade at once requested that the act of 1854 be amended by the substitution of the "Danube" rule for the determination of propelling-power deductions, and that the deductions in the case of any steamer be limited to 50 per cent of the gross tonnage. No action was taken upon this recommendation, consequently the Board of Trade the following year proposed that the rules of the act of 1854 governing propelling-power deductions be repealed and that a law be enacted requiring propelling-power deductions to be determined by the measurement of machinery spaces and fixed coal bunkers; but the proposal of the board in 1867, like that made in 1866, was ignored. However, it may be noted in passing that the rule recommended by the Board of Trade in 1866 was in 1871 adopted by the European Commission of the Danube, and thereby came to be called the Danube rule, while the suggestion made by the Board of Trade in 1867 was in 1873 adopted by Germany, and is thus often called the German rule.

The decision of the European Commission of the Danube not to adopt the percentage rule for the determination of propelling-power deductions is significant. This commission, made up of representatives of the commercial powers of Europe, had been established in 1856 to improve navigation at Sulina, at the mouth of the Danube, and to collect charges upon vessels entering and clearing the mouth of the river. In 1860 the European Commission of the Danube decided to base shipping charges upon net tonnage as determined by the British act of 1854, and a scale of percentages was worked out to be applied to the net tonnage of the vessels of other countries than Great Britain for the purpose of reducing to common terms all tonnage upon which tolls were levied. This plan did not work satisfactorily, and in 1871 the commission adopted the so-called Danube rule, which had originated in England in 1854, and was the rule by which propelling-power deductions were made by the act of 1854 for screw-propelled steamers whose engine-room space did not come between 13 and 20 per cent of the gross tonnage, and for paddle-wheel steamers whose engine-room space did not come between 20 and 30 per cent of the gross tonnage. In other words, the rule which the British act applied to smaller and larger vessels but not to ships of medium size was by the Danube commission applied to all vessels, with the additional provision that the total deduction for propelling power should not exceed 50 per cent of the gross tonnage. This action of the European Commission of the Danube was taken largely through the influence of Sir John Stokes, a man of great ability, who was the representative of Great Britain on the European Commission of the Danube for 15 years, from 1856 to 1871.[1]

Though the Board of Trade was unsuccessful in the efforts made in 1866 and 1867 to eliminate the percentage rule concerning propelling-power deductions from the Merchant Shipping Act of 1854, further efforts were made in 1871, 1872, 1874, and 1881. In 1871 the Board of Trade had a bill introduced into Parliament providing for propelling-power deductions according to actual measurement. The following year the Board of Trade again proposed the adoption of the Danube rule and the same proposition was made two years later. This last bill, that of 1874, was referred to a select committee of the House of Commons. The principal witnesses that appeared before the select committee were Sir (then Colonel) John Stokes; Mr. Thomas Gray, assistant secretary at the head of the marine department of the Board of Trade; Mr. Thomas H. Farrer, the permanent secretary to the Board of Trade, and representatives of the large steamship companies and of certain dock companies and harbor boards. Sir John Stokes stated to the select committee

[1] Sir John Stokes may properly be ranked next to Mr. George Moorsom as an authority upon tonnage and measurement rules. In addition to representing the British Government on the European Commission of the Danube for 15 years, Sir John Stokes was one of the two delegates of the British Government to the International Tonnage Commission of Constantinople in 1873. He was a very influential member of that body. Later he served for some time as the representative for the British Government on the council of administration of the Suez Canal Co.

that "the object of the Constantinople commission was to arrive at a single method of measuring tonnage by all nations * * * and to remedy the defects of the law of 1854, both as regards the deductions for engine and crew spaces and the definition of covered-in spaces above the uppermost deck." Sir John Stokes also expressed the opinion that the adoption by Parliament of the provisions of the bill of 1874 "would give entire effect to the recommendations of the international commission (of Constantinople). My private opinion is that it would be followed eventually, perhaps not immediately, by the adoption of the same rule by all nations as regards net tonnage." The representatives of the big steamship companies opposed the abandonment of the percentage rule, and inasmuch as no action was taken by Parliament it is probable that the influence of the steamship companies was stronger than the recommendations of the Board of Trade.

The final effort made by the Board of Trade to bring about the determination of propelling power deductions for all vessels by applying the Danube rule instead of by applying the percentage rule to most ships, was made in 1881, when the subject of the measurement of tonnage was investigated and reported upon by a royal commission consisting of 12 members, of whom 2 were Sir John Stokes and Mr. Thomas Gray.[1] This report, which is reproduced as Appendix XVIII to this volume, was an exceptionally able presentation of the reasons for substituting for the rules in the act of 1854 governing propelling-power deductions rules substantially the same as had been formulated at Constantinople for the Suez Canal Co. The Suez rule, it will be recalled, made propelling-power deductions of $1\frac{3}{4}$ the engine-room space in screw-propelled vessels and $1\frac{1}{2}$ the engine-room space in paddle-wheel steamers, with the proviso that the deductions for propelling power in the case of steamers with fixed coal bunkers might, if the owner of the vessel preferred, be determined by the actual measurement of the space occupied by machinery and fuel. Again, however, the opposition of the owners and builders of ships prevailed and recommendations of the Board of Trade were not adopted by Parliament.

After 1881 the Board of Trade made no further attempt to eliminate the percentage rule from the act of 1854, but it has secured one important amendment to the rules governing propelling-power deductions. This was in 1907. Prior to that time the law did not limit deductions for propelling power to any maximum percentage of gross tonnage. A high-powered steamer might, under the Danube rule, which determines the deduction authorized by the British act of 1854 for vessels whose engine-room space is 20 per cent or more (for screw steamers), or 30 per cent or more (for paddle-wheel vessels), of the gross tonnage, have a very low or even a negative net tonnage. The Suez rules have always limited propelling-power deductions to 50 per cent of the gross tonnage, except in the case of tugs.

The dock companies finding that their charges based upon net tonnage were bringing in but small revenue from large passenger ships, sought to have a limit placed upon deductions from gross tonnage, and in 1906 the Board of Trade appointed a select committee to investigate and report upon the question of limiting propelling-power deductions to a certain percentage of gross tonnage. The majority of the committee adopted the views of the shipowners and reported as follows:

> We think that it is undesirable to make any change unless strong reasons can be shown for its necessity, and after carefully considering all the evidence we are of opinion, having regard to the fact that relatively low tonnages are to be found only in a very small percentage of the total tonnage of British shipping, and also the serious objections on international grounds to changes in the tonnage law, sufficiently strong reasons for making a change do not exist at the present time. We are therefore not prepared to recommend any change in the present law.[2]

The expert members of the committee did not concur in the majority report. In 1907 the Board of Trade brought about the appointment of a parliamentary "select committee on tonnage deduction for propelling power," which, after considering much the same evidence as had been presented the previous year to the special committee appointed by the Board of Trade, recommended[3] that propelling-power deductions be limited to 55 per cent of the gross tonnage after

[1] Report by Her Majesty's commissioners to inquire into the present operation of the law for the measurement of tonnage, 1881. This is volume 49 of the Reports from Commissioners, Inspectors, and Others, Session January 6 to August 27, 1881.

[2] Report of Special Committee Appointed by Board of Trade, 1906 (Cd. 3045), p. 2.

[3] Report of Select Committee on Tonnage Deduction for Propelling Power, 1907 (C. 256), p. IV.

all other deductions (for crew and navigation spaces) have been made. A law fixing this limit was enacted to become effective on January 1, 1914.[1]

Though the British dock companies, harbor authorities, and Government departments interested in levying upon shipping reasonable charges for services rendered, and charges so imposed as to be as fair as possible to all types of ships, have been prevented by the opposition of the shipowners from bringing about the abandonment of the percentage rule concerning propelling-power deductions, the reasons for changing the rule are stronger to-day than they formerly were. The deduction for propelling power of an arbitrary percentage of the total closed-in capacity of the vessel, instead of making the deduction vary with the space required for machinery and used for fuel, causes the difference between power space deducted and power space occupied to increase with every advance in the efficiency and compactness of engines, with every reduction in the space required for fuel, and with every addition made to the number of decks, and thus to the closed-in capacity of vessels. The main objections to the percentage rule may be briefly enumerated as follows:

1. Propelling-power deductions under the percentage rule usually exceed the space occupied by machinery and fuel, and the rule thus operates to subsidize certain classes of vessels.

2. The percentage rule often causes space to be wasted [2] for the purpose of making the engine room include somewhat more than 13 per cent of the space included in gross tonnage. The economy due to compactness of engines is thus partly destroyed. Freight vessels now being put into service, equipped with internal-combustion engines, are built, by stipulation of the owners, with engine-room space above 13 per cent of the gross tonnage, in order that the vessels may secure propelling-power deductions equal to 32 per cent of the gross tonnage.

3. The percentage rule is responsible for the indefensible practice of increasing the volume of light and air spaces included in the engine room when an increase is necessary to bring the engine-room space above 13 per cent of the gross tonnage. If the engine room of a freight steamer contains over 13 per cent of the space included in gross tonnage, without including, either in gross tonnage or in the engine room, the light and air space above the upper deck, then the light and air space above the upper deck is not included; but if the extra light and air space is needed to bring the vessel under the percentage rule as to power deduction the additional light and air space above the upper deck may, in pursuance of a request in writing to the Board of Trade by the owner of the ship, be included in gross tonnage and the engine room. The rule is such that the size of the engine room may vary with regard to the ratio between the engine-room space and gross tonnage and not solely with regard to the space occupied by the machinery.[3]

If a vessel, measured for registry in Great Britain, has an engine room too small or too large to bring the vessel under the percentage rule as to propelling-power deductions, the owner of the ship may request the entire light and air space to be included in the engine room, in order that the power deductions under the Danube rule (the rule that the law applies to such vessels) may be as large as possible.

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[1] See Appendix III for act of 1907.

[2] The testimony of Sir James Flannery, a shipbuilder of London, Liverpool, and Rotterdam of 40 years' experience in ship construction, before the Parliamentary Select Committee of 1907, is typical. The following colloquy occurred:

"Q. And further, there is an artificial increase of propelling space. How much, from your experience, does that come to?

"A. The propelling power in dead-weight carrying vessels is practically always 14 per cent, and whether your vessel has engines that will drive her 8 or 10 or 12 knots, your dead-weight vessel has always got practically the same percentage from 13½ to 14, so as to qualify for this bonus.

"Q. As little above 13 per cent as they can get, I suppose.

"A. Exactly. I have known it so little above 13 per cent that the engineer's storeroom has had to be broken down, a partial hulkhead and a grating put in front of it, so as to allow just a little more space in the engine room to qualify for the 32 per cent." (Report of Select Committee on Tonnage Deduction for Propelling Power, 1907, p. 262.)

[3] Through an oversight in drafting the act of 1854 it was not specifically stated that a space not included in the gross tonnage may not be deducted. The Board of Trade assumed that to be the intention of the law, and therefore included light and air spaces below the upper deck as part of the engine room, but refused to include in the engine room (and thus in the space deducted) the light and air space above the upper deck. In the case of the *Isabella* (High Court of Justice, Queen's Bench Division, London & North Western Ry. *v.* William Fraser, Apr. 3, 1879), the High Court of Justice held, in 1879, that light and air spaces above the upper deck must be deducted with the engine room, even though they have not been included in the gross tonnage. The gross injustice of this ruling was remedied in the Merchant Shipping Act of 1889, which prohibited the deduction of any space which had not been included in the gross tonnage. This act, however, still made it possible to juggle with light and air spaces by stipulating that such spaces, if located above the upper deck, shall ordinarily not be measured into the space occupied by the propelling power, but that they may be so included upon request of the owner to the Board of Trade.

It is not necessary to argue that the spaces included in the engine room—the spaces occupied by propelling machinery—ought to be definitely defined by the measurement rules, and that the size of the engine room should depend upon the space occupied by the machinery and required for its working. The manipulation of rules concerning engine-room space with a view to lightening tonnage charges ought not to be possible. The rules governing power deductions should be fair and should be the same at all times for all vessels of the same type.

4. The application of the percentage rule to some vessels and the Danube rule to others may treat vessels of practically the same size unfairly. If a screw steamer of 6,000 tons gross has an engine-room space equal to 13.2 per cent of the space included in gross tonnage the propelling-power deduction will be 1,920 tons (6,000 by 0.32). If the engine-room space in a ship of the same gross tonnage is only 13 per cent of the space included in gross tonnage, the deduction would be 1,365 tons (6,000 by 0.13 by 1.75). A difference of but 12 tons in the capacities of the engine rooms of the two vessels would produce a difference of 555 tons in deductions for propelling power.

On the contrary, if the engine room of a screw steamer of 6,000 tons gross occupied 20 per cent of the closed-in space the propelling-power deduction would be according to the Danube rule, and would amount to 35 per cent, or to 2,100 tons; whereas if the engine-room space was 19.8 per cent of space included in gross tonnage the deduction for power would be 32 per cent, or 1,920 tons. The difference of 12 tons in the capacity of the two engine rooms, in this instance, makes a difference of 180 tons in the deduction for propelling power. These illustrations suffice to show that to treat vessels fairly as regards propelling-power deductions the same rule should be applied to all ships of the same type.

5. Under the percentage rule the excess of the space included in power deductions over the space actually occupied by machinery and fuel becomes increasingly larger. There are several reasons for this:

(*a*) The increase in the number of decks, and thus of the volume of closed-in space above the "upper" deck, has caused the total closed-in volume and the gross tonnage of vessels to enlarge so rapidly that the engine room tends to become a smaller percentage of the total capacity of vessels. Otherwise stated, freight vessels of a given engine power have an increasing percentage of their total capacity available for cargo—a smaller percentage of the total closed-in volume being occupied by machinery and fuel.

(*b*) Marine engines tend to become more efficient, to develop greater power per unit of size, to become more compact. Moreover, internal-combustion engines, the use of which has already begun, may occupy less space than steam engines do.

(*c*) The increasingly efficient marine engines consume less coal or oil per unit of power generated or of work done. The coal space required per unit of engine power tends to decline, and the use of oil instead of coal in many ocean vessels is further reducing the space that is required for fuel. Diesel engines and gas engines consume much less fuel than steam engines do, and should engines that consume the fuel in the cylinders become of general use, as is quite possible, there will be a still further reduction made in the space required for fuel.

(*d*) Stations at which vessels may obtain coal or fuel oil are becoming more numerous, and vessels being able to secure coal or oil more frequently en route are able to reduce the size of coal bunkers and fuel tanks and thus to give more space to cargo.

From these facts it must be evident that there can be no permanent general ratio between the size of the engine room and the gross tonnage of vessels. If the percentage rule for propelling power deduction had been accurate in 1854, it could not have long remained accurate. As a matter of fact the percentage rule, as Mr. Moorsom and the Board of Trade officials promptly pointed out, provided at the outset for propelling power deductions in excess of the spaces occupied by machinery and fuel.

6. The deduction for propelling power of more space than is used for machinery and fuel, i. e., the exemption from net tonnage and thus from the various charges on shipping, discriminates in favor of the steamer and against the sailing vessel. When the act of 1854 was passed the steamship was in the early stages of its development. It had not become a profitable

carrier of general freight, much less of bulk cargoes. The sailing vessel was the principal freight carrier. Special favors to steamships might be excused if not justified in 1854, but hardly at the present time. It is unjust to the sailing vessel as well as an unwise public policy to make net tonnage of sailing vessels—the tonnage upon which charges are levied—their entire earning capacity and to make the net tonnage of steamships much less than their earning capacity.

When it became evident that the British Government was to adhere to the percentage rule for propelling power deductions, instead of accepting the rule that had been adopted by the International Tonnage Commission at Constantinople, other nations incorporated the percentage rule in their measurement laws. It was not to be expected that the commercial nations would adhere to a rule different from that enforced by the country whose marine comprises nearly half the world's ocean shipping. The United States and Germany adopted the percentage rule in 1895. Had the Suez rules for power space deduction been adopted by Great Britain in 1874 or in 1881, when efforts were made to amend the act of 1854, it is certain that the commercial countries of the world would also have taken similar action.

III. The Danube Rule.

The so-called Danube rule was first adopted as the sole rule governing propelling-power deductions by the European Commission of the Danube. This action was taken in 1871 upon the recommendation of the British Board of Trade and through the influence of Sir John Stokes, Great Britain's representative on the commission of the Danube.[1]

The rule adopted by the commission of the Danube in 1871 was taken, with changes in phraseology, from the British Merchant Shipping Act of 1854, the commission of the Danube limiting the total deduction for propelling power to 50 per cent of the gross tonnage. The Danube rule was of British origin and first appeared as a part of the act of 1854, at which time, as has been explained, the present Board of Trade rule as to propelling-power deductions was adopted. That rule, it will be recalled, applied the percentage method of determining propelling-power deductions to screw steamers whose engine-room space came within 13 and 20 per cent of the space included in gross tonnage and to paddle-wheel steamers whose engine rooms occupy between 20 and 30 per cent of the space included in gross tonnage, and provided that—

> As regards all other ships the deduction shall, if the Board of Trade and the owner both agree thereto, be estimated in the same manner; but either they or he may, in their or his discretion, require the space to be measured and the deduction estimated accordingly, and whenever the measurement is so required the deduction shall consist of the tonnage of the space actually occupied by or required to be inclosed for the proper working of the boilers and machinery, with the addition in the case of ships propelled by paddle wheels of one-half and in the case of ships propelled by screws of three-fourths of the tonnage of such space.[2]

The owners of vessels with low-engine power—i. e., steamers whose engine room occupies 13 per cent or less, and paddle-wheel steamers whose engine room occupies 20 per cent or less of the space included in gross tonnage—would prefer to have the deduction made by the percentage rule; but the Board of Trade requires the application of the Danube rule in order to avoid making excessive deductions for propelling power. In the case of vessels whose engine rooms are too large to bring the vessels within the percentage limits, vessel owners, having an

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[1] In 1874 Mr. Thomas H. Farrer, permanent secretary of the Board of Trade, testified before the Select Committee on Tonnage (p. 146): "The Danube commission adopted, with the help and advice of the Board of Trade, the rules * * * for the measurement of engine room."

In 1911 Mr. Kuhl, the consulting engineer of the European Commission of the Danube, stated in a letter written March 25 to the resident engineer of the commission at Sulina:

"About 1870 the tonnage measurement officers of the European Commission of the Danube, in verifying the tonnage certificates of steamers based on the Moorsom system, found a great many anomalies resulting from the deduction of engine room, bunkers, etc. These results were communicated to the Board of Trade. Mr. Thomas Gray was the chief man, if I remember correctly. With the consent of the Board of Trade new rules were elaborated and put into force by the European commission. Sir John Stokes, the British commissioner, was the moving spirit in this as in all other matters concerning the commission."

[2] The rule as adopted in 1871 by the European Commission of the Danube was phrased as follows:

"The allowance to be made for the space occupied by engine room and coal spaces shall be estimated as follows, that is to say: The allowance shall consist of the tonnage of the space occupied by or required to be inclosed for the proper working of the machinery and boilers, with the addition for coal space of 75 per cent thereof in the case of ships propelled by screws and 50 per cent thereof in the case of ships propelled by paddle wheels, provided that, except in the case of steamers used exclusively for the purpose of towing, the whole allowance made for the propelling power on account of engine-room and coal space together shall not exceed one-half of the gross tonnage of the ship. (For copy of Danube tariff and complete measurement rules see British Accounts and Papers, 1874, vol. 68, Commercial No. 7, pp. 20–25.)

option between the percentage and Danube rules, choose the Danube rule for propelling-power deductions, because a larger deduction in tonnage can thereby be secured.

The Danube rule not only originated in Great Britain, in the Merchant Shipping Act of 1854, but, as has been explained, successive efforts were made in 1866, 1872, 1874, and 1881 to secure parliamentary action making that rule the sole one for the determination of propelling-power deductions. It is true that Mr. Moorsom, the tonnage expert of the Board of Trade, favored the actual measurement of spaces occupied by machinery and fuel, and that from 1860 till stopped therefrom, in 1866, by the decision of the High Court of Justice, the Board of Trade deducted the space actually occupied by power and fuel as determined by the rule of 1836 amended and improved; but Mr. Moorsom, in 1860, suggested to the Board of Trade that if it could not adopt the actual-measurement rule, it would be well to apply to—

All vessels, indiscriminately, that part of the present system, based on the size of the actual engine room, which at present is applied only to vessels in which the said engine rooms are beyond the limits of the prescribed percentages; that is, by taking $1\frac{1}{2}$ the actual engine room for the allowance of all paddle vessels and $1\frac{3}{4}$ for the allowance of all screw vessels. This modification of eliminating altogether the percentages from the system removes its great and unjust anomalies; but still admits of unfair advantages to the extreme power coasters, a defect which could, however, be arrested in its further progress without risk of prejudice to the longer-voyage steamers, by limiting the allowance in the most extreme case, as suggested by the local marine board of Glasgow, to one-half of the entire tonnage of the ship.[1]

When, in 1866, the Board of Trade was required to resume the enforcement of the rule for propelling-power deductions as formulated by the Merchant Shipping Act of 1854, it at once recommended the enactment of a law eliminating the percentage rule and providing for the application of the "Danube" rule to all vessels.

In adopting the "Danube" rule for propelling-power deductions, the European Commission of the Danube chose that rule after experimenting with the Board of Trade rule. The eight members of this commission[2] represented most of the principal powers of Europe—Great Britain, France, Germany, Austria-Hungary, Italy, Roumania, Russia, and Turkey. As stated in an earlier part of this chapter, the commission was established by the treaty of Paris in 1856, and it promptly undertook the deepening and correction of the channel of the Danube below Braila and along the Sulina Branch. The minimum depth at Sulina was increased from 9 to 24 feet, and the depth of the Sulina Branch from 8 to $18\frac{1}{2}$ feet.

When the commission's first tariff was issued, the charges upon shipping were based upon the net tonnage of vessels as determined by the British Merchant Shipping Act of 1854; and, as has been explained, the net tonnage of vessels under other flags was multiplied by such a factor as would make the product equal to what the vessel's tonnage would have been under the British flag. This plan was adopted as a temporary expedient, it being the hope and expectation of the commission that the commercial powers of the world would unify tonnage rules and vessel measurements. As early as 1861 the commission formally announced its desire that a "universal system of tonnage be adopted in order to establish a real equality between ship and ship and between flag and flag."[3] From time to time the Commission of the Danube repeated this expression of its hope for the international unification of tonnage; but, as no action was taken by the powers, the commission requested the British Board of Trade for advice as to the tonnage rules to be permanently adopted by the commission.

The Board of Trade advised the Commission of the Danube to adopt the rule for propelling-power deduction which the board had, in 1866, sought to have Parliament adopt in place of the rule established by the act of 1854. The Commission of the Danube adopted the rule exactly as it was phrased in the memorandum submitted by the Board of Trade. This was in 1871, and thus it was that the name "Danube" was given to that part of the British rule of 1854 that applied to screw steamers whose engine-room tonnage did not come between 13 and 20 per cent

[1] The report and documents submitted to the Board of Trade by Mr. Moorsom in 1860 have been printed several times. They may be found in the appendix to the Report of the Merchant Shipping Committee of 1862; Report of Select Committee on Tonnage of 1874, Appendix 4, pp. 228–231; and the Report of the Royal Commissioners of 1881, Appendix 22, pp. 659–662. Mr. Moorsom makes the same points in a paper "On the new tonnage law as established in the Merchant Shipping Act of 1854" in the Transactions of the Institution of Naval Architects (1860), Vol. I, pp. 128–144.

[2] The commission is still in existence. Since 1904 it has been continued for successive periods of three years and will so continue, unless the powers represented on the commission give a year's notice of withdrawal from representation on the commission.

[3] Statement of Sir John Stokes, Report of Select Committee on Tonnage, 1874, p. 3.

of the gross tonnage and to paddle-wheel vessels whose engine rooms did not occupy more than 20 per cent, nor less than 30 per cent, of the space included in gross tonnage. The Commission of the Danube abolished the percentage rule and did not give vessel owners the option of having the actual space occupied by machinery and fuel deducted. The single rule of deducting for propelling power $1\frac{3}{4}$ the engine-room space in screw steamers and $1\frac{1}{2}$ the engine-room space in paddle-wheel vessels was applied to all vessels subject to the charges imposed by the commission. The total allowance for propelling power was limited to 50 per cent of the gross tonnage.

IV. The Suez Rules.

The concession which the Suez Canal Co. received from the Ottoman Government authorized the company to charge tolls of 10 francs per ton of capacity. The concession did not define "ton of capacity," and during the construction of the canal no consideration was given to the meaning of the words. In 1868, the year before the Suez Canal was finished, the company appointed a special commission to consider questions connected with the construction of the canal. This commission the following year recommended that "in the absence of any international rules for the determination of the tonnage of vessels it would be best to base the toll to be charged upon the net tonnage of ships as stated in the ship's papers without discrimination as to the flag of vessels." [1] This first commission did not attempt to define "ton of capacity" nor did it formulate rules for the measurement of vessels to determine the tonnage upon which the Suez tolls should be levied. It was expected in 1869 that the commercial powers of Europe would agree upon uniform tonnage and vessel measurement rules, but this expectation was not realized.

From the opening of the Suez Canal in 1869 to the 1st of July, 1872, the tolls were levied upon the net tonnage of vessels as stated in their certificates of registry. The revenues derived by the company from the tolls levied upon this basis did not enable the company to meet its fixed charges, and as the rate of tolls could not be increased the company, in 1871, appointed a second commission to investigate and report upon the question of the tonnage basis of the company's tolls and other charges. This second commission recommended that the tolls be levied upon the gross tonnage of vessels, and this recommendation was adopted to take effect July 1, 1872.

This action of the company increased the tolls for vessels of different classes from 30 to 50 per cent, and the shipping interests in different countries protested to their several Governments which brought pressure to bear both upon the Suez Canal Co. and upon the Ottoman Porte to compel the company to base the tolls upon net tonnage. The Porte, being unable to decide whether the canal company or the protesting Governments had properly defined "ton of capacity," assembled the International Tonnage Commission at Constantinople in September, 1873. The question submitted to the commission was "the determination of a standard ton which will serve both as a unit for commercial transactions and also as a unit on which to collect the tolls to which navigation is subject." Thirteen Governments—Germany, Great Britain, Austria-Hungary, Belgium, Spain, France, Greece, Italy, Holland, Russia, Norway, Sweden, and Turkey—sent delegates. The principal powers instructed their delegates to limit their deliberations to the consideration of tonnage with reference to the tolls payable for the use of the Suez Canal. The international commission was thus not to consider the problem of the international unification of tonnage rules; but, as a matter of fact, the conference did devote itself to the formulation of measurement rules which, it was expected, would be adopted by the countries represented at the conference as well as by the Suez Canal Co. The report of the international commission and the measurement rules which it formulated are contained in Appendices X and XII to this volume.

The International Tonnage Commission gave full consideration to the respective merits of the three rules for propelling power deductions—the British rule of the act of 1854, the German

[1] Consult Appendix XI, which contains a history of the measurement of tonnage of vessels using the Suez Canal written by Lieut. V. Beret.

(or actual measurement) rule, and the Danube rule. The percentage rule was not favored by the international commission and was not supported by the British delegates. Sir John Stokes was one of the two representatives of Great Britain and one of the most influential men in the international commission.

The instructions given by the colonial secretary, Earl Granville, to the British representatives at Constantinople stated that "with regard to measurement for tonnage dues, it is probable that the commission may not adopt the English net or register tonnage, which is in some respects admitted to be defective." During the deliberations of the tonnage commission, Sir John Stokes discussed at length the different rules for propelling power deduction and advocated the adoption of the rule which the Danube commission had put in force in 1871. Other members of the commission advocated the actual measurement rule which had just been adopted by Germany, Austria, and Italy.

The international commission adopted the Danube rule, with an additional provision giving the owners of ships with fixed bunkers the option between the Danube and actual measurement rules. The report of the commission upon this subject was as follows:

It is recognized: * * *

That as regards the net tonnage of steamships the enactments of the English law of 1854 are not all that could be desired, inasmuch as for a class of vessels whose engines occupy a certain proportion of the total capacity, the deduction is one of a percentage of the gross tonnage, while in other ships the deduction is derived only from the space occupied by the engines.

That there exist two other systems under which deductions are made, and the difference between these two consists in the mode of dealing with the coal bunkers. The first regards movable bunkers, and is governed by the Danube rule; the other regards fixed bunkers, and is adopted in Germany, Austria, France, and Italy. Under the first of these systems a shipowner is free to employ his ships for commerce generally throughout the world, increasing or diminishing the space applicable for coals according to the requirements of each voyage, while by the other system he is obliged to adopt fixed bunkers inapplicable for cargo, and which can only hold coals for a certain duration of voyage. Considering that the opinions are divided upon the respective advantages of these systems, the commission recommends for the acceptance of the maritime powers the modes of procedure hereinafter contained, and the rules of measurement annexed to the present report.

The principles of the report were followed out by the commission in formulating the rules for propelling-power deduction that were incorporated in the tonnage rules prepared for the Suez Canal Co.; i. e., propelling-power deductions in the case of vessels with movable bunkers were to be by the Danube rule, and the deductions for vessels with fixed bunkers were to be made either in accordance with the Danube rule or the actual measurement rule, as the owner of the vessel might elect. The total deductions for propelling power were not to exceed 50 per cent of the gross tonnage except in the case of tugs.[1]

The international commission had framed its rules with a view to their being accepted and put in force by the powers represented at Constantinople; but the expectation of the International Tonnage Commission that the rules formulated at Constantinople would be generally adopted by the commercial countries of the world was not realized. The Board of Trade, as has been explained, sought to have the rules adopted by Parliament. In testifying before the

[1] The rules adopted by the International Tonnage Commission for propelling-power deductions have not since been changed. They comprise articles 14, 16, 17, and 18 of the present Suez rules. As originally adopted and as they now stand the rules read as follows:

"ARTICLE 14. For vessels propelled by steam or other mechanical power deduct—

"(2) The spaces occupied by the engines, boilers, coal bunkers, shaft trunks of screw steamers, and the spaces occupied between decks and in the covered and closed-in erections on the upper deck surrounding the funnels, and required for the introduction of air and light into the engine rooms and for the proper working of the engines themselves. Such deductions can not exceed 50 per cent of the gross tonnage.

"ART. 16. In ships that do not have fixed bunkers but transverse bunkers with movable partitions, with or without lateral bunkers, measure the space occupied by the engine room, and add to it, for screw steamers 75 per cent and for paddle steamers 50 per cent of such space. By the space occupied by the engine room is to be understood that occupied by the engine room itself and by the boiler room, together with the spaces strictly required for their working, with the addition of the space taken up by the shaft trunk in screw steamers and the spaces between decks which inclose the funnels and are necessary for the admission of air and light into the engine rooms.

"ART. 17. In ships with fixed coal bunkers, measure the mean length of the engine and boiler room, including the coal bunkers. Ascertain the area of three transverse sections of the ship (as set forth in the rules given in arts. 3 and 4 for the calculation of the gross tonnage) to the deck which covers the engine. * * * The tonnage of the following spaces between decks, and in the covered and closed-in erections on the upper deck, is ascertained by the same method, viz: (*a*) The spaces framed in round the funnels, (*b*) the spaces required for the admission of light and air into the engine rooms, and (*c*) the spaces, if any, necessary for the proper working of the engines.

"ART. 18. Instead of the measurement of fixed bunkers, the rules for bunkers with movable partitions as set forth in article 16 may be applied." (See Appendix XII to this volume, pp. 410-411.)

select committee to which this bill of 1874 was referred, Sir John Stokes said in favor of the bill pending in Parliament:

> This bill would give entire effect to the recommendation of the international commission. * * * The recommendations of the international commission have been embodied in the bill now before the House of Commons. If it becomes a law in England there can be no doubt but other nations will speedily on their parts also adopt the recommendations of the commission, and thus a uniform system of tonnage for the whole world will shortly be recognized.

As has been pointed out, the bill of 1874 failed because of the opposition of the steamship owners, as did also the bill of 1881, although the Royal Commission on Tonnage of 1881 submitted a strong report in favor of the Danube rule.[1] It is most unfortunate that Parliament did not adopt the Suez rules for propelling-power deductions as contained in the bill of 1881. At that time the British rule as contained in the act of 1854 had been adopted by only two other countries—Denmark and Sweden—and those countries had improved the rule by limiting the propelling-power deduction to 50 per cent of the gross tonnage. At that time France gave vessel owners the choice between the British rule and actual measurement. The actual-measurement rule was then in force in Germany, Norway, Portugal, Italy, Austria-Hungary, and Belgium.

Holland, Spain, Turkey, the Suez Canal Co., and the European Commission of the Danube were making propelling-power deductions according to the Suez rules. The following year, 1882, the United States adopted the Danube rule. It is thus clear that had the British Parliament, in 1881, adopted the Suez rules as to propelling-power deduction the action of Great Britain would have soon been followed by the principal countries of the world. When, however, Great Britain refused to change the rule contained in the act of 1854, other nations in the course of time felt obliged to adopt the British rule. Japan acted in 1884, Norway in 1893, the United States and Germany in 1895, Holland in 1899, Russia in 1900, Spain in 1902, and France in 1904.

V. Superiority of the Suez Rules over the Percentage Rule for Propelling-Power Deduction.

The Suez rules as to propelling-power deduction give the owners of ships the option between the deduction of the space actually occupied by machinery and fixed fuel compartments and the deduction of the space occupied by the engine room (including the space occupied by the engines, boilers, shaft tunnel, and designated light and air spaces) increased by 50 per cent for paddle-wheel vessels and by 75 per cent for screw-propelled ships. The deduction of the space actually occupied by machinery and fuel is not practicable in the case of vessels that do not have fixed bunkers. The deductions for such vessels, and hence their net tonnage, would have to be determined by making an arbitrary allowance for fuel, and that would be satisfactory neither to the payer nor to the recipient of shipping charges. It would give rise to serious administrative difficulties and would invite fraudulent practices. It would be necessary to combine with the actual-measurement rule either some such percentage rule as that in the British Merchant Shipping Act of 1854 or some rule like the Danube rule.

The Danube rule, with the option of the actual measurement of machinery and fuel space, is much preferable to the present Board of Trade rule, which is the percentage rule (supplemented by the Danube rule for exceptional vessels). Although no method can be devised of making propelling-power deductions other than by the actual measurement of the spaces occupied by machinery and fuel—which in the case of vessels with movable bunkers is impracticable—that will automatically cause the deductions to correspond exactly with the space used for power purposes in vessels of many different types, the Danube rule works with approximate accuracy, because for vessels of different size and speed there is a rough average relationship between the space occupied by machinery and the space required for fuel. Although the Danube rule can be claimed to secure only approximately accurate propelling-power deductions, it is much more accurate than the deduction of a fixed percentage

[1] See Appendix XVIII for the text of the report of the Royal Commission on Tonnage, 1881.

of gross tonnage, for there is no fixed or general relationship between the space occupied by machinery and fuel and the space included within gross tonnage.

The Suez rule, for the following reasons, is superior to the present Board of Trade rule regarding propelling-power deductions:

1. The Danube rule is based upon the general principle that there is an average relationship between the space occupied by machinery and the space required for fuel, whereas the percentage rule is based upon the inaccurate assumption of a general relationship between propelling-power space and gross tonnage. In previous chapters of this report it has been pointed out that there has been a much larger increase in gross tonnage than in the size of the engine room. Additional decks and superstructures have increased gross tonnage without correspondingly affecting the space required for propelling power. Engines of the same power, because of increased efficiency, tend to occupy less space, and thus further to distort the percentage relationship between power space and gross tonnage. The increasing efficiency and greater compactness of the marine engine has not as yet very greatly altered the relation between machinery space and fuel space. The marine engine of to-day requires less fuel per unit of power result than engines formerly required. The more compact engine requires smaller fuel space than was formerly needed.

2. The percentage deductions for propelling power authorized by the present Board of Trade rule are largely in excess of the space occupied by machinery and fuel in the majority of ocean vessels. The 32 per cent rule at the beginning provided for unduly large propelling-power deductions, and the discrepancy between power space occupied and space deducted has, for the reasons just stated, grown steadily greater. Indeed, the percentage rule is maintained for the very purpose of keeping net tonnage, and thus charges payable upon shipping, as low as possible. It is not claimed that the percentage rule brings about a fair average deduction for propelling power.

The Danube rule, as the experience of the Suez Canal Co. shows, provides for a liberal, but not excessive, deduction for propelling power. The fact that the owners of vessels prefer to have the deductions made in accordance with the Danube rule, rather than by the actual measurement of machinery and fuel spaces, shows that the Danube rule is sufficiently liberal. Both the Board of Trade and the Suez rules allow propelling-power deductions for screw steamers whose engine-room space equals or exceeds 20 per cent and for paddle-wheel vessels whose engine-room space equals or exceeds 30 per cent of the gross tonnage, to be made according to the Danube rule. In the case of vessels with the highest powered engines it is necessary, in order to keep the deduction for machinery and fuel within reasonable bounds, to limit the deductions within a stipulated maximum. The Suez rules limit power deductions to 50 per cent of the gross tonnage and the Board of Trade rules, effective January 1, 1914, to 55 per cent of the gross tonnage after the deductions, other than those for power spaces, have been made. The limits placed by the two sets of rules are practically the same.

3. The percentage rule is now causing vessels to be built with larger engine rooms than are needed. Space is being wasted in order to make the engine room large enough to enable the owner of the vessel to secure propelling-power deductions of 32 per cent of the gross tonnage. Even vessels now being fitted with Diesel engines, are given engine rooms slightly in excess of 13 per cent of the entire space included in gross tonnage. In this way the economy that should result from the use of the more compact engines now being constructed is partly nullified.

When the Danube rule is applied in making propelling-power deductions, shipbuilders and shipowners have no incentive to increase the size of the engine room above the space required for the convenient operation of the machinery.

4. The present Board of Trade rule allows some vessels the advantages of a deduction of 32 per cent for propelling power and denies that favor to other vessels. Screw-propelled steamers within the 13 to 20 per cent limit and paddle-wheel vessels within the 20 to 30 per cent limit are unfairly favored as contrasted with vessels with smaller engine rooms. The Danube rule, on the contrary, is relatively fair as between ships. The same rule is applied to all vessels, whatever the size of their engine room. The possibility of dealing unjustly with any particular vessel

having fixed bunkers is minimized by the option which the Suez rules give the owners of such vessels to choose whether the deduction shall be made by the Danube rule or by actual measurement of machinery and fuel spaces. Likewise, the possibility of reducing unduly the net tonnage of, and the charges payable by, fast steamers with exceptionally high-powered engines is prevented by limiting propelling-power deductions under the Suez rules to 50 per cent of the gross tonnage. This limitation prevents unfair discrimination between ordinary freight vessels and fast passenger steamers.

VI. Conclusion.

The general conclusion or lesson to which the history of the rules for propelling-power deduction points is that the Suez rule—the Danube rule with the option, when practicable, of the actual measurement of machinery and fuel spaces—is the one that should be incorporated in the code of rules to be followed in determining the tonnage upon which Panama Canal tolls and other charges shall be paid. The percentage rule is not to be recommended; it is not based upon correct principles, and it would not treat vessels with relative fairness. If it were applied to vessels using the Panama Canal, the tonnage upon which tolls were paid would not approximate the earning capacity of vessels as closely as is desirable.

The Danube rule is recommended. Ships of different classes will be treated with approximate fairness absolutely and relatively, if propelling-power deductions are made by applying the Danube rule supplemented by the three provisions:

1. That the owners of vessels with fixed fuel compartments may, if they choose, have the deductions determined by the measurement of the space actually occupied by machinery and fixed fuel spaces.

2. That the total deduction for propelling power shall not exceed 50 per cent of the gross tonnage.

3. That the light and air and funnel spaces to be included in the engine room and to be excluded from measurement and gross tonnage shall be definitely defined, and that the same rule as to the inclusion and exclusion of light and air and funnel spaces shall be applied to all vessels without variation and without the exercise of any option on the part of vessel owners.

It is believed that the adoption for Panama of the Suez rule as to propelling-power deduction will prove to be a step toward the ultimate international unification of tonnage rules. The Suez rule is not only right in principle, but is made permanent by having been formulated for the company by an international commission. The same rule is followed by another international commission—the European Commission of the Danube. The incorporation, by the United States Government, of the Suez power-deduction rule in the Panama Canal measurement code will give the Danube rule added prestige. Whether the precedent thus established will prove strong enough to cause the leading commercial nations to amend their tonnage rules, time alone can determine; but should Great Britain and other countries decline to modify their rules as to propelling-power deductions, the enforcement of the same, or approximately the same, rules at the world's two great interoceanic highways will be of no small advantage to shipping and commerce.

CHAPTER X.

PROPELLING-POWER DEDUCTIONS FOR VESSELS EQUIPPED WITH OIL AND GAS ENGINES.

CHAPTER X.

PROPELLING-POWER DEDUCTIONS FOR VESSELS EQUIPPED WITH OIL AND GAS ENGINES.

The general principle upon which the Panama measurement rules accompanying this report are based is that net tonnage should express, as nearly as practicable, the actual earning capacity of vessels—their space available for passengers and cargo. To give effect to this principle it is necessary that deductions made from gross tonnage in determining net tonnage should correspond as closely as is feasible with the spaces required for the crew, for navigation purposes, and for propelling power.

The largest deduction from gross tonnage is for the space occupied by the engine and fuel, and it is especially important that the deduction for propelling power should be made by applying a correct rule. This is not an easy problem to solve. Vessels are of many types, employed in widely different services. Moreover, vessels of the same size and speed and employed in the same service may be equipped with different kinds of engines, varying as regards the space they occupy and the kind and quantity of fuel used.

The marine engine is having a rapid development at the present time. The standard type of reciprocating steam engine is being improved; oil instead of coal is being used to generate steam; the turbine engine is being tried out in service; and new types of engines, such as the internal-combustion oil and gas engines, are being successfully employed in marine service. The substitution of oil for coal in the furnaces of steam engines lessens the space required for fuel, while the use of internal-combustion instead of steam engines largely reduces the fuel consumed and may somewhat reduce the size of the engine room.

In view of these facts it seems desirable to study the effects of oil fuel upon fuel space and the effects of internal-combustion engines upon the size and location of fuel compartments and upon the size of the engine room for the purpose of deciding whether the same rule for propelling-power deduction may properly be applied to vessels equipped with all types of engines. Consideration is first given to the relative fuel spaces required by coal-burning and oil-burning engines of like power. In order to make the discussion of internal-combustion engines clear to nontechnical readers, a brief description is given of the main kinds of oil and gas engines now in use for marine service.

The kinds of fuel that may be used in internal-combustion engines determine the sources of the supply of fuel for such engines, and the sources of supply may affect the location of the stations at which fuel may be secured and the amount that vessels must carry in actual service. Moreover, the nature of the fuel oil may determine whether it may or may not be stored in the double bottom or other portions of the ship that are not available for the stowage of cargo. It has accordingly been deemed necessary to present a short discussion of fuel oils used in internal-combustion engines.

The purpose of this chapter is to consider the relative space required for propelling power (including engine room and fuel compartments) by steam marine engines and by internal combustion marine engines, to ascertain the net saving in cargo space that results from equipping a vessel with an internal-combustion engine instead of with one driven by steam power, and to decide whether it is or is not advisable to make propelling power deductions from gross tonnage, in the case of vessels with internal-combustion engines, in accordance with a different rule than is applied in the case of ships with steam engines—to decide whether the use of oil and gas marine engines makes it desirable to supplement the Danube rule with a special rule applying only to the internal-combustion engines. The chapter also considers whether the substitution of oil for coal as the fuel for steam engines calls for a special rule for propelling power deduction.

Vessels using oil for fuel may be broadly classified as (1) oil-burning steamships; (2) vessels fitted with internal-combustion oil engines; and (3) vessels equipped with internal-combustion gas engines. Each of these groups includes different types; but, from the standpoint of tonnage measurement as well as from the point of view of the principles of engine construction, the threefold classification indicates the essential differences. These three types of oil-burning marine engines will be considered in turn.

I. OIL-BURNING STEAMSHIPS.

The number of steamships equipped with oil-burning engines is increasing rapidly. The latest vessels added to the American-Hawaiian Co.'s fleet, for instance, are equipped to burn oil; likewise the Pacific Mail Steamship Co. has equipped the four largest vessels of its fleet with facilities for using oil fuel, these vessels being used in the trans-Pacific service. Oil as a fuel is especially favored by the owners of tank steamers and in general it is to be expected that oil instead of coal will be used by a steadily growing share of ocean steamers.

All three of the rules applied in making deductions for propelling power were formulated with reference to engines using coal for fuel and no modification has been made in these rules because of the substitution of fuel oil for coal in the furnaces of a relatively large number of ocean vessels. Whether the same rules may fairly be applied in making propelling-power deductions for both oil-burning and coal-burning steamers ought to be carefully considered. The deductions for propelling power ought to approximate the space required for machinery and fuel in order that the net tonnage of vessels may correspond as nearly as practicable to the capacity of vessels for the accommodation of passengers and cargo.

The space occupied by the engines and boilers is practically the same whether coal or oil be used for fuel; indeed, some steamers are equipped to burn either coal or oil in the furnaces. Mr. R. P. Schwerin, the vice president of the Pacific Mail Steamship Co., which operates both oil-burning and coal-burning steamers, states that "the space required for engine and propelling machinery would very rarely be affected by the kind of fuel used, as practically the same machinery would be used in either case." [1]

Unless there is a material difference in the relative volume of the spaces required for coal and fuel oil, the deductions for propelling power may be made by applying the same rule both to oil-burning and coal-burning engines. The space occupied by engines and boilers being the same in the case of both kinds of steam engines, the question to determine is whether the application of the Danube rule to propelling power deductions in the case of oil-burning engines will unduly favor vessels equipped with such engines.

In considering this question, it is especially important to bear in mind that the fairness of the application of the Danube rule for propelling power deductions—the deduction of actual propelling machinery space plus 75 per cent—is in no way affected by the fact that the fuel oil is carried in double-bottom compartments while coal is carried in bunkers. When double-bottom compartments are used to stow oil, such compartments are included in gross tonnage, just as bunker spaces used for coal are included. Propelling-power deductions made under the Danube rule, it will be recalled, are in nowise affected by any increase or decrease in gross tonnage, the Danube rule being superior to the Board of Trade percentage rule in this regard. The fairness of the deductions made under the Danube rule depends solely upon the relation of the volume of the spaces occupied by fuel and the volume of the spaces occupied by machinery. The specific question, and the only one to be considered in determining whether the Danube rule should be applied to propelling power deductions in the case of oil-burning steamers, is whether the space occupied by fuel oil is so much less than the space required for coal as to call for a modification of the Danube rule. Regarding the relative spaces actually occupied by fuel on coal and oil burning steamers, Mr. Schwerin states that:

> Theoretically, oil fuel would occupy approximately 50 per cent of the space required for coal fuel. On this coast (the Pacific) we usually allow 4 barrels of oil per ton of coal. Taking coal at 42 cubic feet per ton and oil at 5.61 cubic feet per barrel, the actual space occupied would be as 42 is to 22.44. In other words, the oil would occupy 53.4 per

[1] From letter dated Apr. 4, 1913.

cent of the space occupied by the coal. On the Atlantic coast, where better coal is obtained, 4½ barrels of oil per ton of coal would probably be more accurate. On this basis the oil fuel would occupy 60 per cent of the space required for coal. On the other hand, with oil the entire space is filled, while with coal certain pockets are naturally void and the space between the floors of the ship is not filled with coal. Therefore it would be fair to assume that even with the best quality of coal the actual space required for oil would amount to about one-half the space required for coal.

The secretary of Lloyd's Register of British and Foreign Shipping, in a letter written June 28, 1913, estimates that "steam-engine vessels using oil" require, for similar voyages, fuel spaces of about 62 per cent of the fuel spaces needed by "steam-engine vessels using coal."

Inasmuch as the space occupied by fuel oil need not be more than about 60 per cent of the space required for coal, it is evident that the application of the same power-deduction rule to both oil-burning and coal-burning steamers favors the oil-burning vessel to an appreciable extent. It should be noted, however, that the Danube rule favors the oil-burning vessel less than does the Board of Trade percentage rule, because of the fact that the stowing of fuel oil in double-bottom compartments causes those compartments to be included in gross tonnage. A vessel of the same size would have a comparatively greater tonnage under the British measurement rules if equipped with oil-burning steam engines than if equipped with coal-burning engines. The 32 per cent deduction for propelling power when made by the percentage rule is thus greater for vessels having smaller fuel compartments.

Under the Danube rule the relatively favorable treatment accorded oil-burning, as compared with coal-burning, steamers is frequently less than would appear to result from the difference in the spaces required for oil and coal fuel. When all or a portion of the fuel oil is carried in the double-bottom compartments, the net tonnage of the oil-burning steamer is increased by the tonnage of the space occupied by fuel-oil compartments. Theoretically, the vessel's cargo capacity would be increased by the number of tons added to the net tonnage of the vessel by the stowage of oil in double-bottom compartments instead of in tanks taking up a part of the vessel's hold. In actual practice, however, the increase in cargo capacity does not equal the space added to the net tonnage by including in the tonnage the volume of the double-bottom compartments used for oil. Ordinarily there is some gain in cargo space, but in some instances there is none. This is due to the fact that the space occupied by coal bunkers—space not required when oil is used for fuel—is not always usable for cargo.

11. VESSELS WITH INTERNAL-COMBUSTION OIL ENGINES—PRINCIPAL TYPES OF ENGINES.

The oil-burning engine differs from the coal-burning engine merely in the use of oil instead of coal to develop steam in its boilers. Both are steam engines of the same type quite unlike the internal-combustion oil engine which consumes the fuel in the cylinders, its power being derived not from steam generated in boilers but from the combustion of oil upon its injection into the cylinders.

The type of internal-combustion oil engine at present most widely in use is the Diesel engine, which was first put into practical service in Germany in 1897.[1] Dr. Rudolf Diesel, the inventor of the engine, had been experimenting for some time, an experimental engine having been completed in 1893. He had, indeed, applied for a patent in the United States in 1891, and one was granted July 16, 1895.[2] The first Diesel engines were for stationary service, but marine engines were constructed in 1902–3. Since 1903, thousands of stationary Diesel engines have been constructed and sold throughout the world; and in November, 1911, there were, according to Mr. Diesel, 365 vessels equipped with Diesel marine engines. The number of vessels fitted with these engines is increasing.

The Diesel oil engine differs in principle from a gas engine, it being an internal-combustion engine, while the gas engine is an internal-explosion engine. The Diesel principle is to burn the oil in the cylinder; while the principle of the gas engine is to convert the fuel oil or coal into gas which explodes in the cylinder.

[1] R. Diesel, Present Status of the Diesel Engine in Europe, pp. 1 and 7.

[2] Power, Mar. 11, 1913, p. 338.

As first constructed the Diesel engine was of the four-stroke cycle type. This type works as follows:[1] On the first stroke of the piston, air is sucked into the cylinder from the atmosphere, the cylinder being full of air at atmospheric pressure at the end of the stroke. The second or return stroke compresses the air in the cylinder to about 500 pounds per square inch, thus raising its temperature to between 1,000° and 1,100° F. During the third stroke fuel oil in the form of a fine spray is injected into that part of the cylinder that contains the compressed air by a blast of air at higher pressure than that in the cylinder, i. e., at about 800 pounds per square inch; and, as the temperature of the air in the cylinder has by compression been raised above the burning point of fuel oil, combustion takes place. The burning of the oil causes expansion and "work is done on the piston for the rest of the stroke." "In the final [or second return] stroke the exhaust valve remains open, the burnt gases are expelled from the cylinder into the exhaust pipe, and the cycle of operations begins once more, the cylinder being ready to receive a further charge of air on the next out stroke of the piston." [2]

The oil is injected directly into the cylinder in a fine spray but still in liquid form. To convert the oil into a spray and to start the engine by means of compressed air an air compressor is required. There is no electric spark or other artificial ignition necessary, the compression of air in the cylinder producing the temperature required to cause the combustion of the oil. The burning of the oil directly in the cylinder causes a very high temperature, although not so high as the temperature reached in gas engines, and necessitates cooling appliances. The valves and bearings of the piston are ordinarily cooled by circulating water or oil.

The foregoing description applies to the four-cycle type of Diesel engine. There are, however, two other types of Diesel engines, the two-cycle single-acting and the two-cycle double-acting engines. Two-cycle engines are distinctive in that they perform the various operations above outlined in two instead of four strokes.

The first stroke of the two-cycle single-acting engine (the engine being started by compressed air) compresses the air which has been forced into the cylinder by a scavenge pump. Fuel oil is injected by an air compressor into the cylinder, where it is ignited by the high temperature of the compressed air in the cylinder. The second stroke is caused by the expansion due to combustion and is the working stroke. During the second stroke also the scavenge pump expels the burnt gases through the exhaust and refills the cylinder with fresh air.

The two-cycle double-acting engines differ from single-acting engines chiefly in that each stroke is a working stroke. The cylinders of the double-acting engine are really double. Oil is injected alternately at each of the ends of the cylinder—i. e., alternately above and below the piston—thereby causing each stroke to be a working stroke. The two-cycle double-acting engine is described by Mr. A. P. Chalkley as follows:

> Consider the piston in its bottom position when it is fully uncovering the exhaust valves in the center and the space above the piston is full of pure air which has been injected by the scavenge pump, while below the piston in the cylinder is the air which has been compressed to a high pressure in the last downward stroke. The upward stroke is then a combination of the two strokes in the two-cycle single-acting engine already described. Above the piston the air is compressed, while below the piston there is first fuel injection and combustion, then expansion, and finally opening of the scavenge valves, admission of scavenge air and the consequent expulsion of the burnt gases to the exhaust through the exhaust ports which are uncovered as before as the piston reaches the end of its stroke.[3]

The engines here described are vertical stationary engines, but the principles are the same in horizontal engines and are the same in marine as in stationary engines.

Structurally, four-cycle engines differ from those of the two-cycle type in the arrangement of valves and in the necessity of having a scavenge pump. In the four-cycle engine the piston itself removes the burnt gases and fills the cylinder with fresh air. Two strokes are eliminated in the two-cycle engine; but this necessitates a scavenge pump, which is separate from the air compressor. The function of the scavenge pump is to force the exhaust gases out of the cylinder through the exhaust ports and to leave the cylinder at the end of the stroke full of fresh air, all valves being closed.

Each of the three types of Diesel engines is used for marine work; but at present there seems to be a tendency to favor the two-cycle engines. The four-cycle engine is of the highest

[1] See A. P. Chalkley, Diesel Engines for Land and Marine Work, p. 27-28. [2] Ibid., p. 28. [3] Ibid., p. 34.

efficiency, although its two extra piston strokes per cycle consume some energy. Moreover, it requires no scavenge pumps, the energy required to drive which, in the case of the two-cycle engine, gives that type of engine a somewhat lower mechanical efficiency. The four-cycle engine having been in use longer than the two-cycle engines, its builders have had more experience. Presumably, the technical development of the four-cycle engine is more advanced.

In spite of the higher efficiency of the four-cycle engine, however, there are various considerations which have caused some of the more recently built vessels to be equipped with two-cycle single-acting engines. The considerations may be summarized as follows:

(1) The two-cycle single-acting engine requires, to produce the same power, only half the number of cylinders needed in a four-cycle engine. The space required by the two-cycle type and the weight are therefore less than for the four-cycle, even though the latter engine requires no scavenge pump. (2) The two-cycle engine is more easily reversed than the four-cycle, its valve mechanism being less complicated. (3) The two-cycle engine has no exhaust valves, but has ports which the scavenge pump keeps free from foul accumulations, no cleaning being necessary.

The two-cycle double-acting Diesel marine engine requires fewer cylinders than the two-cycle single-acting type. The difficulties [1] encountered in operating the two-cycle double-acting engine have been due to the greater complexity in valve arrangements, to the difficulties with piston-rod stuffing boxes, to the difficulty of cooling the pistons and rods, and to the inaccessibility of parts for overhauling. Very large scavenge pumps are required in double-acting engines, the saving in space and weight due to fewer cylinders being thereby partly counterbalanced. Much less has thus far been accomplished in perfecting the double-acting as compared with the single-acting engine, and it is uncertain whether the two-cycle double-acting or the two-cycle single-acting engine will prevail in the future. Indeed, it is not certain that the four-cycle marine engine will be displaced. Each of the three types of Diesel engines is at present in use, and it is problematical what the future developments will be. In fact, engines of the same type when manufactured, as they are, by many different companies, differ in matters of construction details.[2]

Mr. Diesel believes that the two-cycle type will prevail. He states that "The Diesel engine is really predestined for the two-stroke cycle; it is the born two-cycle engine, and this for the following reasons: (1) Because the scavenging is made with pure air only and not, as in the gas engine, with a mixture of air and gas, so that there is no possibility of fuel losses by scavenging; (2) because there can be given a very great quantity of scavenging air, which insures a perfect scavenging of all the combustion gases. For these reasons there is no doubt to-day that the marine Diesel engine of the future will be of the two-stroke type." [3] There is, however, no consensus of opinion in favor of the two-cycle engine.[4]

Various manufacturers are constructing internal-combustion oil engines on a somewhat different principle than that of the Diesel engine. The so-called "vaporizer oil engines" are a compromise between the Diesel and the gas engine. As above explained, the Diesel engine obtains power from the combustion or burning of oil sprayed into the cylinder, the heat necessary to cause ignition being obtained by the compression of air, while the gas engine obtains power from the explosion of gas in the cylinder, the heat necessary to cause ignition being produced locally by an electric spark or other appliance. Vaporizer oil engines obtain their power from the combustion of oil vapor in the cylinder and the vapor is locally ignited as in a gas engine. They differ from the Diesel engine in that they vaporize the oil and ignite it locally and from the gas engine in that they do not depend upon the explosion of gas. They are equipped with vaporizers which convert the oil into a thin vapor, the more volatile parts of which approximate gas and explode when ignited, while the less volatile parts remain in liquid form and burn as does the sprayed oil in the Diesel engine.[5]

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[1] J. T. Milton, Diesel Engines for Sea-Going Vessels, in Transactions of the Institution of Naval Architects of Great Britain, 1911, p. 61.

[2] E. Shackleton, Modern Developments in British and Continental Oil Engine Practice. Proceedings of the British Institute of Marine Engineers, 1911-12, pp. 53-84, 162; J. T. Milton, ibid., pp. 170-174.

[3] Transactions of Institution of Naval Architects, 1911, p. 81.

[4] International Marine Engineering, March, 1913, pp. 102-104.

[5] W. P. Durtnall, The Internal Combustion Engine. Proceedings of the British Institute of Marine Engineers, 1910-11, p. 391.

There are different makes of vaporizer engines, the variations being mainly in the kind of vaporizer employed, and in the apparatus used for igniting the vapor.[1] Bulb-shaped ignition lamps, igniter balls heated by blow lamps, electric sparks, and other igniting devices are provided to ignite the vapor. Vaporizer engines like those of the Diesel type may be 4-cycle or 2-cycle.

The advantages claimed for vaporizer engines are that they do not require powerful and expensive air compressors, and that they have a cheaper initial cost. In one type of vaporizer engine, for example, the air in the cylinder is compressed to about 150 pounds per square inch instead of to 500 pounds or more, as in the Diesel engine, and the fuel is injected at a pressure of about 400 pounds per square inch instead of at 800 pounds or more, as is required by the Diesel. The high air pressures in the cylinder are avoided by the use of an ignition chamber and by a bulb-shaped ignition lamp.

The disadvantages of the vaporizer, as compared with the Diesel engine, are higher fuel consumption and lower efficiency. There is no universally accepted opinion as to the relative merits of Diesel and vaporizer engines. Both are in actual use, but the Diesel is more widely used and more actively pushed in marine circles. At present it has the lead.

Some engines have recently been constructed with an apparatus for heating the incoming air before compression, thus avoiding the necessity for high air pressures.[2] In other respects these engines are built on the Diesel plan. It is not certain that such engines are sufficiently different from the Diesel to require separate classification, nor have they as yet been constructed in sufficient numbers to warrant discussion in a paper on tonnage measurement

III. FUEL OILS IN INTERNAL COMBUSTION OIL ENGINES.

Many kinds of fuel oil are used in internal-combustion oil engines, indeed, Mr. Diesel has stated that the ordinary Diesel engine can be operated with any kind of oil except tar oils which require a special arrangement, and that "with this arrangement, the engine is universal for any kind of fuel." [3] As a matter of fact, however, not all kinds of oil can be used in actual practice, because the cost of oil, the danger of fire and explosion, and the presence of troublesome chemicals and gases must be considered in the choice of fuel. Gasoline (petrol), naphtha, kerosene (paraffin oil), and other natural oils which have gone through a refining process can be used, but their excessive cost and their deficiency in safety qualities at present prohibit their extensive use in large marine oil engines. Diesel engines can be operated with alcohol,and vegetable and animal oils of various kinds;[4] but in practice these fuels are not extensively used at present, because of being costly or dangerous or of inferior qualities.

Tar or creosote oils, the by-products of the distillation of coal and of the manufacture of coke, are beginning to be used in Diesel engines and may be more extensively used in the future,[5] but such oils require special alterations in the design of the engine. Mr. Paul Rieppel, of the Machinenfabrik Augsburg-Nürnberg, after experiments with many oils, has concluded that—

> The various hydrocarbon oils which occur either as natural products or as the result of distillation either of brown coal, ordinary coal, or crude oils, may be divided into two classes, which differ very much in their behavior when raised to a higher temperature. Those of one class, when raised to such a temperature as is obtained by the compression in Diesel engines, readily decompose into free hydrogen and heavier hydrocarbons; those of the other class at first only vaporize, or partially vaporize, and require much higher temperature than that due to the compression for their decomposition. In those of the first class the hydrogen, because of its easy ignition, burns first, and the resulting heat enables the remainder of the hydrocarbons to become completely burnt, the total combustion taking an appreciable though small amount of time. In the second, a very high temperature is required to initiate combustion, which when commenced approximates to an explosion, owing to part of the oil having been made gaseous becoming mixed with the compressed air and so constituting an explosive mixture. The latter oils, therefore, may be either not properly consumed or they may be burned with explosive violence.[6]

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[1] E. Shackleton, Modern Developments in British and Continental Oil Engine Practice, Ibid. 1911–12, pp. 71–74.
[2] "Power," Mar. 11, 1913, p. 338; International Marine Engineering, April, 1913, vol. 18, p. 173 et seq.
[3] Transactions of Institution of Naval Architects, 1911, p. 81.
[4] R. Diesel, Introduction to Chalkley's Diesel Engines for Land and Marine Work, p. 5.
[5] Ibid., p. 3.
[6] Transactions of Institution Naval Architects, 1911, p. 55.

Mr. J. T. Milton, Lloyd's chief engineer surveyor, quotes with approval the statement of Mr. Rieppel that—

> Even these oils [of the second class] can be used in the Diesel engine by means of special alterations in design, but it would appear that they could not be used in an engine adjusted for the more suitable oils. In general, the oils which are not suitable appear to be the result of distillation of ordinary coal, so that this matter is of more importance to the users of land engines, whilst the oils made from brown coal or from natural crude oils appear to be well suited for Diesel engines.[1]

The oils at present most widely used in internal-combustion marine engines are the heavy crude and residual mineral oils. As compared with gasoline, naphtha, and kerosene they have the advantages of lower cost, greater safety in handling and storing, and greater heat and power efficiency per pound of fuel. Tar oil distilled from coal and brown coal (lignite) is much used, especially in Germany, the distillation from ordinary coal being supplemented with smaller amounts of crude mineral oil to reduce the high flash point.

In oil-producing countries and in countries without import duties on mineral oil Diesel engines are usually run with residual oil, crude oil being also used to some extent. Residual oil, which is heavy mineral oil remaining after the lighter oils such as benzine, gasoline, and kerosene have been distilled, was often wasted as a useless by-product of oil refineries until it began to be used in Diesel engines. Residual oil will continue to be used, but should internal-combustion marine engines come to be widely used, there is no doubt that the crude mineral oil as it comes from the wells will be more widely utilized than at present. The extensive oil fields of California and parts of those in Texas and in the Kansas-Oklahoma field produce heavy fuel oil not so largely used for refining purposes as for fuel in oil-burning steam engines.

Diesel marine engines can be operated with the heaviest crude oils, and such oils, although having a rather low flash point, can be used with safety in Diesel engines. Lloyd's Society has not yet deemed it necessary to establish special rules as to the permissible flash point of fuel oil nor as to the location of fuel tanks on vessels equipped with Diesel engines; but the society's chief engineer surveyor, as the result of an investigation, has stated that—

> Considerations of safety render it necessary to use in ship's boiler furnaces only fuel oils having a comparatively high flash point. This practically shuts out from marine boiler use those crude oils which do not contain sufficient of the lighter hydrocarbons to make it profitable to distil them, but which contain sufficient to give them a comparatively low flash point. If the oils are to be used in closed cylinders instead of in ordinary boiler furnaces there is not the same necessity for demanding a high flash point. Experience has shown that even the extremely volatile petrol (gasoline) can be safely carried in bulk on board ship.[2]

The location of oil fields and the supply of oil which vessels can obtain in different parts of the world will necessarily affect the space that vessels must devote to the storage of oil. Fuel oil is sold at a wide range of ocean fuel stations, and should internal-combustion oil marine engines become more common, the number of oil stations may be expected gradually to increase. Just as the multiplication of coaling stations has reduced the space occupied by coal bunkers, so will the increase in the number of oil stations permit the space required for fuel oil to be smaller on vessels equipped with oil engines.

Fuel oil carried in the double bottom occupies spaces not available for cargo, but when oil is stored in deep tanks, it takes up a part of the hold that ordinarily might be used for cargo. The use of different kinds of oil having a low flash point may influence the location of fuel oil spaces, thereby affecting the relative spaces available for cargo. While Lloyd's Society permits the carriage of oil with a minimum flash point of 150° F. in double bottoms under cargo holds, it is not certain that oils with much lower flash points can be safely carried in that way. Lloyd's chief engineer surveyor expresses the opinion—

> That extended experience has shown that the requirements of Lloyd's rule for oil-fuel bunkers, etc., have proved their sufficiency for safely dealing with heavy oils suitable for boiler fuel having a flash point of not less than 150° F. * * * If, however, oils are to be used for engine fuel which have a low flash point, or which give off a perceptible amount of gas, it will be undesirable to carry them in double bottoms under cargo holds or in spaces from which a

[1] Transactions Institution Naval Architects, 1911, p. 56.

[2] Ibid., p. 55.

leakage would permit of vapors or gas penetrating into cargo holds or other closed spaces where they would be a source of danger.[1]

It is evident from the foregoing statement of Lloyd's chief engineer surveyor that the use of double-bottom compartments for fuel oil must depend upon the kinds of oil consumed. If deep tanks instead of the double-bottom spaces must be used to stow fuel oil, one of the advantages of oil over coal as a fuel is lessened. It may probably be assumed, however, that experience will demonstrate the possibility of carrying the cheaper fuel oils safely in the double bottoms of vessels.

IV. EFFECT OF THE INTERNAL-COMBUSTION ENGINE UPON PROPELLING-POWER SPACES AND SPACES AVAILABLE FOR CARGO.

The evidence presented in the following paragraphs shows clearly that the use of internal-combustion engines reduces the space occupied by propelling power machinery and fuel. The *reduction in propelling machinery space* results mainly from three facts, that there are no boilers, that there are no light and air shafts leading to the boiler room, and that no smoke funnels are required. The practice as to the construction of spaces to admit light and air to the engine room and the practice as to construction of funnels to carry off the gases from the engine room are not yet uniform, and there are, moreover, various plans followed as regards the kind of auxiliary machinery [2] used for navigation purposes. When the auxiliary engines are connected with the main engine room, they form a part of the machinery space which is made the basis of calculating propelling power deductions. At the present time, some ships equipped with Diesel engines for propelling power have donkey engines with steam boilers, while other vessels have donkey engines driven by compressed air or by electric motors with dynamos driven by auxiliary Diesel engines or by steam engines having boilers in which steam is generated by exhaust gases. There is, moreover, as was stated above, no uniformity in the type of engine used on vessels equipped with internal-combustion engines—four-cycle, two-cycle single-acting, and two-cycle double-acting engines being in service. As has been explained, the four-cycle engine, which is largely used for marine service, requires more space than does the two-cycle single-acting engine, which in turn is larger than the two-cycle double-acting engine.

In considering rules for propelling power deductions, the facts just stated must be given consideration. It is evident that the percentage of reduction in engine-room space resulting from the use of internal-combustion, instead of steam, engines is not uniform for all ships. Regarding the relative spaces occupied by propelling machinery in vessels with steam engines and vessels having Diesel engines of like power, the secretary of Lloyd's Register of British and Foreign Shipping states that, "upon a comparison of the existing Diesel-engined vessels with steamers of somewhat similar dimensions, it would appear that the machinery space in the former works out at about 18.75 per cent of the gross tonnage, as compared with 19.85 per cent in the latter type of vessel on the average. In some individual cases the disparity is very much greater." [3]

In order to ascertain the saving in engine-room space that may be effected by the use of internal-combustion engines, letters were addressed to several builders of such engines in the United States and Europe. The information secured from them, which is here summarized, shows that the possible saving in engine-room space varies from 20 to 33 per cent. That this is probably a conservative statement on the part of engine builders is indicated by the fact that when the polar ship *Fram* was equipped with Diesel engines a saving of 45 per cent was effected in the volume of the engine room. According to Mr. Diesel, various small warships have reduced engine-room space 50 per cent by means of Diesel engines.[4]

The Nederlandsche Fabrick van Werktuigen en Spoorwegmaterieé of Amsterdam writes that "the engine-room space required by a Diesel engine is two-thirds of the space required for

[1] Transactions Institution Naval Architects, 1911, p. 56.

[2] W. R. Cummings, Auxiliary Machinery for Internal Combustion Engined Vessels, Proceedings of the British Institute of Marine Engineers, 1911–12, p. 394; J. T. Milton, Transactions of the Institution of Naval Architects, 1911, p. 66; A. P. Chalkley, Diesel Engines, etc., p. 157.

[3] From a letter dated June 28, 1913.

[4] R. Diesel, The Present Status, etc., p. 36.

coal or oil burning steam engines of the same power." [1] The statement of Usines Carels Freres of Ghent, Belgium, is that "the space required by Deisel engines of equivalent power to steam is at least 20 per cent less." [2] The Great Lakes Engineering Works at Detroit writes that 'the engine and boiler room space required by a Diesel engine is 80 per cent of the space for coal or oil burning machinery of the same power." [3] George Clark (Ltd.), Southwick Engine Works, Sunderland, England, states that the space required for the main and auxiliary machinery of Diesel engines is about two-thirds that required for steam engines.[4]

It should be noted, however, that the reduction in engine-room space made possible by the use of Diesel engines is not always effected, because shipowners desire the volume of the engine-room to be slightly more than 13 per cent of the entire space included in gross tonnage, in order thereby to entitle the ship to a propelling power deduction of 32 per cent of the gross tonnage. The percentage rule as to propelling power deduction may thus cause the engine-room to be unnecessarily large—may cause space to be wasted. The evidence of this fact, furnished by engine builders, is instructive.

In describing the *Selandia*, a large Danish vessel of the East Asiatic Co., the vessel's builder stated that [5] "One condition on which the contract for the vessel was made was that the proportion of the engine-room space should be at least the 13 per cent which was required by the tonnage laws, and the engine-room space has accordingly been made 13.2 per cent."

The following statement was made by a large British builder of Diesel engines in describing a merchant vessel equipped with Diesel engines:

> We found that we could reduce the engine room very materially, and so we reduced it as much as possible consistent with getting the 32 per cent reduction in tonnage, which of course we must have. That really fixed the size of our engine room.[6]

Burmeister & Wain, Diesel engine builders of Copenhagen, write as follows:

> The engine-room space required for a Diesel engine can be smaller than that required for engines and boilers in a steamer. In the motor liners we have built up to date we have always been obliged to guarantee that the Diesel engine space was 13.2 per cent of the total cubic space in order to obtain a reduction of 32 per cent; with new rules the space can be a great deal reduced.[7]

Sulzer Bros., of Winterthur, Switzerland, write as follows:

> In consequence of the small number of ocean-going motor boats in service up to the present date it appears rather difficult to give you reliable figures for the purpose in question. In accordance with the international rules for the tonnage measurement of ships, the builders of motor boats in Europe have made use of the provision that 32 per cent may be deducted from the gross tonnage if the engine-room tonnage exceeds 13 per cent of the gross tonnage. To obtain this advantage with motor-driven boats the size of the space for the motor, including all auxiliary appliances, spaces of scavenging air, ventilation, etc., has been made just as large as that used for steam propulsion, in spite of a smaller space being sufficient for motors. Of course the increase of the motor-room space above that required is not solely owing to the reason explained above, but also to the necessity of providing for a donkey boiler space, which in most large steam-propelled boats is avoided by using the main boilers alternately for driving the winches, etc. * * * The engine-room space required by a Diesel motor ship of, say, about 10,000 tons dead weight and less equals that of a boat of the same size and engine power propelled by steam and will probably remain so as long as the present measurement rules are valid.[8]

On merchant ships equipped with internal-combustion oil engines the actual reduction of the machinery space depends, as is indicated by the above quotations, largely upon the tonnage laws, and is frequently much less than it might be in the absence of such laws. The reduction is, moreover, less in some cases than in others, depending upon the type of vessel and the general relation between its machinery spaces and gross tonnage. This influence of national tonnage laws will doubtless continue even though the Board of Trade rule regarding propelling power deductions is not applied at Panama, because all merchant vessels will continue to pay port dues, tonnage taxes, and commercial charges of various kinds on the basis of their national net register tonnage. The owners of the *Selandia*, for example, which is used for trade through the Suez Canal, where the Danube instead of the Board of Trade rule is applied in making

[1] Letter of Apr. 7, 1913.
[2] Letter of May 1, 1913.
[3] Letter of May 12, 1913.
[4] Letter of May 15, 1913.
[5] Transactions of the Institution of Naval Architects, 1912, p. 80.
[6] Transactions of the Institution of Naval Architects, 1911, p. 89.
[7] Letter of Apr. 8, 1913.
[8] Letter of May 6, 1913.

propelling power deduction, thought it necessary to have the ship's engine-room space exceed 13 per cent of the gross tonnage, in order to bring the vessel under the 32 per cent rule when being measured for national registry.

The reduction in fuel space on merchant vessels with internal-combustion oil engines as compared with steamships is of greater importance than any saving resulting from reduced machinery space. Statements as to the relative space required for fuel in a vessel equipped with internal-combustion oil engines, as compared with a vessel having steam engines of like power burning either coal or fuel oil, vary considerably; but the evidence indicates that vessels with internal-combustion engines ordinarily require but 20 to 30 per cent of the volume of the fuel needed by steamers of like engine power. The Secretary for Lloyd's Register, in the letter quoted above, estimates the fuel spaces for Diesel engines to be 26 per cent of the fuel spaces in coal-burning steam engines of like power. Lloyd's chief engineer surveyor states that ordinarily the weight of fuel needed by the Diesel engine is 28 per cent of that required by the steam engine.[1] In discussing this statement, Mr. Diesel asserted that—

> This statement is based only on the figures of consumption per brake horsepower. In practice the proportion is much more advantageous, because the boilers use a good deal of coal by being kept under fire even when there is no work or much less work to do, whilst the Diesel engine only consumes fuel when there is work to do, and the consumption is nearly proportional to the work done * * * In fact the proportion of fuel to be carried with the Diesel engine is only one-fifth, or even in special cases one-sixth, compared with the amount of coal necessary for steam engines.[2]

Usines Carels Freres write as follows:

> The space required for fuel for a Diesel engine as compared with a steam engine of equivalent capacity is not to exceed 25 per cent of that of steam. In the majority of cases the storage space for the oil is provided in the double bottoms and in the ballast-tank space fore and aft of the ship, and does not occupy a single cubic foot of space that is available for cargo.[3]

Burmeister and Wain state that—

> The Diesel engine consumes of oil one-fourth to one-fifth of the quantity of coal to be consumed in a steamer, weight against weight.[4]

The Nederlandsche Fabriek states that—

> The space required for fuel for a Diesel engine is one-fourth of the space required for the oil for an oil-burning engine of like power.[5]

The agent for Lloyd's Register at Philadelphia writes that—

> Dr. Diesel estimates 20 per cent only in weight of oil or one-fifth that required for coal, but the conservative estimate is 30 per cent.[6]

Sulzer Bros. state that—

> The space required for fuel for a Diesel engine is approximately 25 to 30 per cent of that required for coal-burning engines of the same power.[7]

The Great Lakes Engineering Works state that—

> The space required for fuel for Diesel machinery is 25 per cent of the space required for coal-burning machinery of like power.[8]

George Clark (Ltd.), Southwick Engine Works, Sunderland, England, states that—

> The fuel space for the Diesel engine is 75 per cent less than that of the steam engine burning coal or oil, based on a radius of 3,000 nautical miles.[9]

In considering the spaces occupied by fuel on vessels with internal-combustion engines, and in reasoning concerning the present and probable future ratio of the spaces required for fuel by internal-combustion engines and steam engines of like power, the fact must be kept in mind that the internal combustion engine is probably still in the early stages of its development. Conditions may so change as largely to alter present ratios. Moreover, it is to be expected that

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[1] Transactions of the Institution of Naval Architects, 1911, p. 57.
[2] Ibid., p. 81.
[3] Letter of May 1, 1913.
[4] Letter of Apr. 8, 1913.
[5] Letter of Apr. 7, 1913.
[6] Letter of Apr. 10, 1913.
[7] Letter of May 6, 1913.
[8] Letter of May 12, 1913.
[9] Letter of May 15, 1913.

the number of oil stations will largely increase if the internal-combustion engine should come into general use. This would enable ship owners to approach the minimum fuel space necessary for the operation of vessels equipped with internal-combustion engines; but it is at present impossible to forecast how extensively the internal-combustion oil engine will be used or how rapidly the number of oil stations will increase.

Further uncertainty arises from the fact that four-cycle and two-cycle engines, both of which are in actual use, require unlike quantities of oil. Two-cycle engines at present are said to consume from 20 to 25 per cent more oil than do four-cycle engines of the same power. Whether in the future the two-cycle marine engine will displace the four-cycle, or whether both will continue to be used, is uncertain. The two-cycle Diesel engine is being continually improved; and, if it should supplant the four-cycle engine, the change would require more space for fuel oil.

An increase in the dead-weight capacity of vessels results from the saving in machinery and fuel spaces effected by fitting vessels with internal-combustion oil engines. Of two British cargo vessels of the same dimensions and type, it was found that the vessel with Diesel engines gained 200 tons in dead-weight capacity because of weight of fuel saved by having a Diesel instead of a coal-burning engine. In fact, the total saving in dead-weight capacity due to the Diesel engines and fuel oil was 300 tons as compared with the coal-burning steamship. The manufacturer of the Diesel engines used in this vessel made the following statement:

> Our oil engines * * * are heavy, but still we shall save nearly 100 tons as compared with steam engines and boilers of the same power. The difference in weight between coal and oil burned will show a saving of nearly 9 tons per day in the ordinary work of the trade we are considering. Take it, if you like, at only 8 tons per day; these particular ships bunker at the commencement of their voyage for 25 days' steaming, so that you have a saving of 200 tons, that is, 200 tons of additional paying cargo that can be carried owing to having less weight of fuel, besides 100 tons due to the saving in the weight of the engines.[1]

National tonnage laws influence the volume of the engine room, but they do not affect the weight of the engines nor the gain in dead-weight carrying ability due to the use of lighter engines. Mr. Chalkley makes the following comparison between the weight of a Diesel and a steam engine of relatively low power:

> Considering only the slow-speed Diesel engine of the ordinary type as adapted for marine work (e.g., cargo vessels) it has been found that the approximate saving in weight for a 1,500 shaft H. P. installation is somewhere in the neighborhood of 150 tons in favor of the Diesel engine as compared with the steam equipment, and approximately the same ratio applies for larger powers.[2]

The possibility of saving from 70 to 80 per cent in weight of fuel by using the internal-combustion instead of the steam engine is of special importance for freight vessels used to carry heavy bulk cargo. With such ships dead-weight carrying ability is of first moment, whereas, in the case of other merchant vessels, the main consideration is the space or capacity available for cargo.

The use of internal-combustion engines, which are smaller than steam engines (including the boilers) and which require less fuel, *increases the space available for cargo*, and the saving thus secured may be increased by the stowage of fuel oil in spaces that could not be used to carry the coal consumed by coal-burning engines. The net saving actually obtained by substituting internal-combustion oil engines for steam engines depends upon various construction details and upon the influence upon engine-room space exerted by the percentage rule for propelling power deductions. It is, however, the opinion of Mr. Chalkley that—

> Allowing for all the economies effected, namely, in weight of fuel carried, weight of machinery, and in engine-room space, it may be taken as a safe estimate that with almost any class of vessel, an extra cargo can be carried equivalent to about 15 per cent of the displacement of the vessel. This fact makes it apparent that the question of the saving effected in its fuel bill, important though it is, should by no means be the determining factor, and from the shipowner's point of view, the increased earning capacity must be seriously considered.[3]

Vessels are designed for varying services and conditions, and shipowners take advantage in different ways of the economies derived from the internal-combustion oil engine. The *Jut-*

[1] Transactions of the Institution of Naval Architects, 1911, p. 89.

[2] Diesel Engines for Marine Work, p. 143.

[3] Diesel Engines for Land and Marine Work, p. 143. Though the saving due to stowage of oil in places not available for coal is not mentioned in this statement, Mr. Chalkley's book on Diesel engines shows that the author had it in mind.

landia, of 5,000 tons displacement, shows a gain of 20 per cent in freight and passenger space. The *Selandia*, of 10,000 tons displacement, carries 1,000 tons of cargo in excess of what would be carried in case she were fitted with coal-burning steam engines. The *Toiler*, with 3,000 tons cargo capacity, gains but 60 tons. A cargo vessel with a gross tonnage of 5,550 tons, fitted with Diesel engines, was found to have an extra freight-carrying capacity of 280 tons as compared with a sister steamship of the same dimensions.

Bush-Sulzer Bros., of St. Louis, make the following statement:

> The available cargo space of the Diesel ship is equal to that of a steamer of the same size plus the space occupied by the steamer's bunkers, boilers, and a portion, at least, of its auxiliary equipment. A ship designed by E. L. Orde will carry 7,880 tons if steam engined and 8,530 tons if Diesel engined. Orde, therefore, shows that the Diesel ship will carry 7.6 per cent more freight or cargo than a steamer of equal size and power equipped and fueled for the same length of voyage to be made at the same speed in each case. Others have placed this percentage in favor of the Diesel as high as 10 per cent.[1]

Usines Carels Freres state the saving obtained as follows:

> The available space for cargo in a Diesel engined ship is considerably more than that of a steam engined ship. Some designs of Diesel engined ships are shown at 10 per cent and some at 15 per cent increase in cargo carrying capacity, which is due to the space saved and the weight saved of the fuel.[2]

The Great Lakes Engineering Works writes that—

> In a ship of given dimensions equipped with Diesel engines, the available cargo space is 10 per cent more than in a ship equipped with coal-burning machinery.[3]

George Clark (Ltd.) Southwick Engine Works, Sunderland, England, states that—

> The extra cargo capacity available in a Diesel-engined ship is about 10 per cent of the dead-weight carrying capacity.[4]

Inasmuch as some steam engines use oil and others coal for fuel, the Diesel engine needs to be compared with both coal-burning and oil-burning steam engines as regards economies in available cargo space. The oil-burning steamship, which can carry much of its fuel in double-bottom compartments not available for stowing coal, usually has the advantage of the coal-burning steamer in the percentage of the total closed-in capacity of the ship that can be used for cargo. However, the saving in cargo space effected by using internal-combustion engines is greater than can be secured by using oil-steam instead of coal-steam engines. It has been estimated that oil-burning steam engines make a 25 per cent smaller saving in available cargo space than can be secured by using internal-combustion engines instead of coal-burning steam machinery.[5] Others place a higher estimate than this upon the advantages of the internal-combustion engine over the oil-burning steam engine, as regards economy in available cargo space.

V. PRESENT USE OF MARINE INTERNAL-COMBUSTION OIL ENGINES.

The only information as to the number of vessels equipped with internal-combustion oil engines is the statement made by Mr. Diesel, in November, 1911, that there were then 365 such ships in service. About 50 or 60 per cent of these vessels were merchant ships, most of them being vessels of small tonnage. Since 1911 several relatively large freight ships and tank ships with Diesel engines have been put into service, and the prediction of the builders of internal-combustion engines is that such engines will be constructed in the future in large numbers for ocean service.

One important use of Diesel engines is in submarine warships for which internal-combustion engines are, for obvious reasons, peculiarly adapted. Diesel engines have also been installed in some cruisers, gunboats, and mine-laying boats, and it is probable that the internal-combustion engine will find increasing favor with the designers of warships.

It is natural that the builders of tank vessels should give special consideration to the advantages of internal-combustion engines. Many of the oil carriers on the Caspian Sea, the

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[1] Letter of Apr. 19, 1913.
[2] Letter of May 1, 1913.
[3] Letter of May 12, 1913.
[4] Letter of May 15, 1913.
[5] E. Shackleton, Modern Developments in British and Continental Oil Engine Practice. Proceedings of the British Institute of Marine Engineers, 1911–12, p. 63.

Volga, and other Russian rivers have been equipped with internal-combustion engines. Some large tank vessels in service on the ocean also are equipped with Diesel engines. The largest ship with Diesel engines in service in the early part of the year 1913 was a tank steamer of 15,000 tons carrying capacity. This vessel constitutes one of the fleet of the German-American Petroleum Co.

It is predicted by Mr. Diesel and others interested in the internal-combustion engine that large sailing vessels will be constructed with auxiliary engines of the internal-combustion type. Some such vessels are now in service, and it is claimed that this type of vessel will be found to be an economical carrier of freight over long ocean routes where fuel is scarce and expensive. Whether this shall prove to be true future experience will determine.

While the use of the internal-combustion oil engines in general cargo and passenger vessels must still be considered to be in the early stages of development, the prospect seems favorable for the internal-combustion engine. Several vessels ranging from 5,000 to 10,000 tons displacement are now operated successfully with such engines and more vessels of that size and type are now being constructed. Some much larger are in service.

VI. THE INTERNAL-COMBUSTION GAS ENGINE.

Description of the gas engine.—The gas engine, like the Diesel engine, consumes the fuel in the cylinder, the general difference being, as has been pointed out, that the oil sprayed into the cylinder of the Diesel engine burns, while the fuel forced into the cylinder of the gas engine, being in gaseous form, explodes upon ignition. Mr. William T. Durtnall differentiates the internal-combustion oil and gas engines in the following concise manner:

> A clear distinction should be made between engines which use fixed gases, forming, when intimately mixed with air, an explosive mixture, which can be ignited by a purely local application of heat (such as that given by an electric spark), and engines of the Diesel type, in which the fuel, in a very divided state, but still in liquid, and not gaseous, form, is distributed throughout the body of air necessary for combustion, such air being heated throughout its mass to a temperature sufficiently high to burn the hyrdocarbon. This process of combustion is certainly not of the nature of an explosion, whereas the ignition of fixed gases by electric spark or hot tube approximates to a true explosion.[1]

Gas engines may be divided with reference to the fuel used into two classes: (1) Engines operated with gasified gasoline, naphtha, kerosene, or other light refined oils, and (2) engines operated with producer gas usually made from coal. The engines of the first class are well adapted to use upon small vessels, such as yachts, pleasure launches, and river boats; while engines of the second class, for reasons that will be explained later, are preferable for the machinery of large vessels.

Gas engines using producer gas must have a producer plant, which consists of three principal parts—a producer, in which coal is heated; a scrubber, in which the gas that has been driven off from the coal is cooled and washed; and a drier, in which the gas is dried and from which it is fed into the cylinders of the engine. In some instances gas producers are also classified as suction producers and pressure or down-draft producers, the latter type being successfully used with a greater variety of low-grade fuels.[2]

The cylinders of the gas engine driven with producer gas are larger than those in which gasoline gas is used. Producer gas is weaker than gasoline gas and larger valve areas are required; and, in order to enable the engine to obtain high efficiency, greater compression in the cylinders must be provided for when producer gas is used. The gas engine, like the internal-combustion oil engine, may be of the four-cycle or two-cycle single-acting or the two-cycle double-acting types.

Advantages and disadvantages of the gas engine.—The chief merit of the producer-gas engine is the cheapness of the gas used for power. Producer gas can be made from "practically all grades of fuels of any commercial value without reference to the proportion of sulphur or tarry compounds that they contain. Several of the poorest grades of bituminous coal show remarkable efficiency in the gas producer, and lignite and peat are used with great facility." [3]

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[1] Wm. P. Durtnall, The Internal Combustion Engine, Proceedings of the British Institute of Marine Engineers, 1910-11, p. 390.
[2] U. S. Bureau of Mines, Technical Paper 9, pp. 17-22 (1912).
[3] Ibid., pp. 20-21.

As compared with the internal-combustion oil engine, the gas engine has certain marked limitations, among which may be enumerated the following:

(1) The producer-gas engine, which is the one best adapted to marine service, must be equipped with a gas-producer plant and provision must be made for stowing coal from which to manufacture the gas. There is, consequently, little saving in engine space or weight to be secured by using the gas engine instead of a steam engine, while as compared with Diesel machinery, gas engines require a greater weight of fuel and more space for the stowage of the fuel. Furthermore, on account of the operation of the gas producer, a larger labor force is required to operate the gas engine than is needed for the Diesel engine.

(2) In order to economize in fuel cost, it is necessary for producer gas used in marine engines to be manufactured from bituminous, lignite, or other inexpensive coals. Anthracite is too expensive. It is possible to use low-grade coals in manufacturing producer gas, but the trouble resulting from the formation of tar in the production of gas has not yet been overcome.

(3) The use of light refined oils for marine gas engines is not commercially practicable, because of the high cost of such oil and because of the danger of carrying such fuel on vessels. By providing special arrangements to insure safety, oils of a low flash point can be carried, but they can not be carried in the double bottom and other portions of the vessel not available for cargo. It is generally agreed that the successful gas engine is one using gas produced from bituminous or lignite coals.

(4) It is more difficult to reverse the gas engine than the Diesel engine. Mr. Chalkley stated, in a volume published in 1912, that "A satisfactorily reversible gas engine is at present hardly an accomplished fact, and speed variation is a difficult problem."[1] Other engineers believe that a mechanism by which the gas engine may readily be reversed will be developed without serious difficulty.[2]

Extent to which gas engines are used.—At the present time gas engines are used mainly as stationary engines. According to the United States Bureau of Mines, there were in 1912 between 900 and 1,000 producer gas plants in the United States. The engines using the gas thus made had a total horsepower of 187,140. According to the Bureau of Mines, there was an increase of 68 per cent in the horsepower of these engines during the period from 1909 to 1912.[3]

Gas engines operated with gasified gasoline or other light refined oils have been installed in large numbers in yachts and small boats, and a small number of such engines are in use in coastwise and lake vessels and are employed as auxiliary engines in a few sailing vessels. For marine service, the internal-combustion oil engine is preferable to the gas engine, but the fact that there are no petroleum fields in Great Britain and that good bituminous coal is cheap in that country causes English engineers to take a special interest in the possibility of developing the gas engine for marine work. Thus, while the Diesel engine seems to be preferred to the gas engine, it is possible that inventors may yet enable the marine gas engine to compete successfully with internal-combustion oil engines. However, the chief engineer surveyor of Lloyd's Society is not hopeful regarding the future development of the marine gas engine. His opinion is that:

> I think the first of these engines that will be successful at sea will not be gas engines, they will be oil engines. With oil fuel we save the whole of the space occupied by the gas-making plant. If oil can be got fairly cheap, and in many parts of the world it can be obtained cheap, it will be found that oil fuel for internal-combustion engines will have a great advantage over any coal whatever. When we come to long-distance ships, the question of the cost of fuel is only one item. The question of space occupied by it is a very important matter * * *. There can be no doubt that oil fuel will have the advantage there, not only because it will give more heat per ton, but also because it does away with all gas-producing plants.[4]

Comparison of gas engines with steam and Diesel engines as regards weight of machinery and space occupied by machinery and fuel.—The gas engine has little advantage over the steam engine either in weight of machinery or in the space occupied by the engine. The steam engine has boilers, which the gas engine does not have, but in place of the boilers there must be the gas

[1] Diesel Engines for Land and Marine Use, p. 136.
[2] A. C. Holzapfel, Gas Power for Ship Propulsion. Transactions of the Institution of Naval Architects (1912), pp. 89–90.
[3] U. S. Bureau of Mines, Bulletin 55, pp. 58–60.
[4] Proceedings of the British Institute of Marine Engineers, 1910–11, p. 132.

producers. The gas engines require less coal-bunker space than steam engines do, and thus there is some space saved by using gas instead of steam power. The space required for the stowing of fuel is less for the Diesel than for the gas engine, mainly because much of the fuel oil used by the Diesel engine can be stowed in the double bottom and other portions of the ship not available for cargo.

The statement of the Holzapfel Marine Gas Power Syndicate (Ltd.), of London, however, indicates that the marine gas engine can be so constructed as to be as economical of engine space, exclusive of space required for fuel, as a Diesel engine. The statement is quoted not only to present the opinion just stated but also to show that the application of the 32 per cent rule for propelling power deductions prevents shipowners from securing the space economies that might be obtained from the substitution of internal combustion for steam engines:

> For gas-driven vessels about the same space is required as for oil-driven vessels, provided that the producer gas plant is placed on deck, which we found is the only suitable place for this purpose. In this country (England) the tonnage laws are such that, unless at least 13 per cent of the total under-deck space is occupied by machinery, the usual reduction of 32 per cent for machinery space from gross tonnage to net tonnage is not allowed. * * * For this reason, and until such time as the British Board of Trade modifies the law or practice in regard to measuring net tonnage of power-driven vessels, it is not likely that vessels driven by oil or gas engines will have less than 13 per cent of the total under-deck tonnage in engine space. As soon, however, as this law has been altered, we consider that 9 or 10 per cent of the under-deck tonnage would be about sufficient space for a tramp ship of the usual speed of 8 to 10 knots.[1]

VII. CONCLUSION.

The specific tonnage question, to which the use of the marine internal combustion engine gives rise, is whether the same rule as to propelling power deduction shall be applied to vessels equipped with internal combustion engines as to vessels having steam engines. Two questions are, in fact, involved; one being whether vessels of different power equipment—vessels with coal-burning and oil-burning steam engines and with internal combustion oil and gas engines of different types—will be treated with relative fairness if the Danube rule is applied to all ships in making tonnage reduction for propelling power. The other question is whether the application to all types of vessels of a single rule for propelling-power deductions will seriously violate the principle that the spaces not deducted from gross tonnage, i. e., the net tonnage, shall approximate the earning capacity of vessels.

In reaching a conclusion upon these questions, it is important to keep in mind two facts as to the effect upon gross and net tonnage of using double-bottom compartments to stow fuel oil:

(*a*) When double-bottom compartments are used to stow fuel oil, the space thus used is added to gross tonnage by the tonnage rules of most countries and by the Panama measurement rules contained in this report. When the Danube rule is followed in making propelling power deduction, the spaces occupied by fuel, whether in the double bottom or elsewhere, are not specifically deducted, the allowance for fuel spaces being a percentage of the space occupied by machinery. From this, it follows that the equipment of a vessel with engines that use oil instead of coal for fuel, and that stow all or a part of the fuel oil in double-bottom compartments, increases both the gross and net tonnage and the theoretical cargo capacity of vessels thus equipped.

(*b*) The Board of Trade percentage rule and the Danube rule affect differently the net tonnage of vessels that use double-bottom spaces to stow fuel oil. The gross tonnage of a vessel being increased by the stowing of fuel in the double bottom, the deduction for propelling power, when made under the 32 per cent rule, is larger because of the use of the double bottom. Thus the percentage rule for propelling power deduction is more inaccurate when applied to vessels having internal combustion oil engines than when applied to steamships—the substitution of Diesel engines for steam machinery would, under the British measurement rules, allow a larger deduction for smaller space occupied by machinery and fuel.

This error is avoided by applying the Danube rule to propelling-power deductions. An increase in the gross tonnage of any particular vessel has no effect upon the tonnage deducted

[1] Letter of Apr. 7, 1913. In this quotation, "under-deck" tonnage is used in the sense of gross tonnage.

for propelling power, and it is unnecessary to consider whether fuel is carried in bunkers, tanks, or double-bottom spaces. For the purpose of illustration, it may be assumed that a vessel having a gross tonnage of 5,000 tons, not including any double-bottom spaces, is fitted with oil-burning engines, and that arrangements are made to carry fuel oil in 20,000 cubic feet (200 tons) of double-bottom compartments. If it be assumed that the machinery of this vessel occupies a space equivalent to 600 tons, the deduction for propelling power would be 1,050 tons (600 by 1.75), and an increase of 200 tons in the gross tonnage will not increase the propelling-power deduction. Thus the tonnage of the vessel, less propelling-power deductions, when no double-bottom compartments were used for fuel would be 3,950 tons, and when the double-bottom compartments were used, 4,150 tons. The increase in net tonnage would be the same as the addition to gross tonnage. Presumably this addition to net tonnage would be accompanied by a greater or less increase in available cargo space. The fact that the substitution of internal combustion for coal-burning steam engines increases both the gross and net tonnage of vessels without increasing the propelling-power deduction when made under the Danube rule should be given much weight in deciding whether it is or is not necessary to apply to vessels equipped with internal-combustion engines a rule for propelling-power deductions different from the rule applied to vessels having steam engines.

If the Danube rule for propelling-power deduction be applied to vessels equipped with internal-combustion oil and gas engines—i. e., if the deduction be made one and three-fourths the space occupied by machinery—vessels having Diesel and gas engines will be treated more liberally than will ships equipped with steam machinery. The facts presented in this chapter show that the machinery spaces required by marine internal-combustion engines average from one-fifth to one-third less than the spaces occupied by marine steam engines of like power. There is some, but at the present time not a large, variation in the spaces required for internal-combustion engines of different types. Vaporizer engines and gas engines using gasoline or other refined oils for fuel are somewhat less in volume than are Diesel engines of corresponding efficiency, while gas engines using coal-producer gas require somewhat more space than do Diesel engines. This theoretical saving in space is, however, largely offset at the present time by the general application of the 32 per cent rule in making propelling-power deductions, and oil and gas engines have thus far had comparatively little effect upon the size of engine rooms.

The fuel spaces required by Diesel and gas engines are much less than the spaces needed for the coal or oil consumed by steam engines of the same power. Diesel engines require but 20 to 30 per cent of the weight of fuel used by coal-burning steam engines, and it is claimed that the actual fuel economy of Diesel engines is greater than this, because fuel consumption stops completely when the engines are not running. Vaporizer engines require somewhat more fuel space than is necessary for Diesel engines. Gas engines operated with refined oils consume a larger volume of fuel than do Diesel engines, while gas engines operated with coal producer-gas need more space for fuel than do other internal-combustion engines. The amount of fuel actually carried by vessels equipped with internal-combustion engines depends upon such variable factors as the number of stations at which fuel oil can be obtained, the prices of oil at different stations, and the length or shortness of the routes over which the vessels are operated. Some of the factors which determine the space used for fuel by vessels having internal-combustion engines are changing, but it is certain that the application of the same rule for propelling-power deductions to all types of vessels will favor those having internal-combustion oil and gas engines much more than those equipped with coal or oil-burning steam engines.

If the Danube rule is followed in making propelling-power deductions in the case of vessels equipped with internal-combustion engines, the owners of such vessels should be given the option of having the deductions made by the actual measurement of machinery and fuel spaces. Vessels operated over short routes carry a comparatively small amount of fuel as compared with vessels in service over long routes. The Danube rule takes this fact into account and provides for a deduction that approximates the space occupied by coal on vessels of different classes employed in various services. Coal-burning steamers, when coaled for voyages of maximum length, may devote to the stowage of fuel spaces in excess of three-quarters the volume of

the engine room. Such vessels may, if only fixed bunkers are used, under the Suez rules, have the actual spaces occupied by machinery and fuel deducted for propelling power. It might possibly, although it probably would not, happen that some vessels equipped with internal-combustion engines might, when dispatched upon exceptionally long voyages, carry fuel occupying spaces exceeding three-quarters of the volume of the engine room. To meet this possible contingency, a Danube rule for propelling-power deduction should always be accompanied by the alternative of deduction according to actual measurement.

If any modification of the Danube rule is to be made to apply to vessels equipped with internal-combustion engines, it would probably be advisable to base such modification upon a division of such vessels into two, or possibly three, classes. If the grouping were into two classes, the first group would include coal and oil burning steamships and vessels equipped with coal producer gas engines; and the second class would contain vessels having internal-combustion oil engines and gas engines using refined oil for fuel. If a threefold division were made, the third class would include oil-burning steamers and vessels equipped with coal producer gas engines. This threefold grouping would leave in the first class only coal-burning steamships, to which the Danube rule without modification would, of course, be applied.

It does not seem advisable, however, at the present time, to make any modification in the Danube rule and it is recommended, for the following reasons, that the same rule for propelling-power deductions be applied to vessels with oil-burning steam engines, internal-combustion oil and gas engines, and coal-burning steam machinery:

(1) While there is a relatively large number of oil-burning steamers now in service, and while it is probable that the number will increase, it is not deemed necessary to make any modification in the Danube rule because of the use of such vessels. Their machinery space is the same as the space required for coal-burning steam engines, and the difference in the volume of the spaces occupied by fuel oil and by coal, while relatively large, is not deemed great enough to necessitate the immediate adoption of a special rule applying only to the comparatively small number of vessels now equipped with oil-burning steam engines.

(2) The number of large deep-sea merchant vessels equipped with internal-combustion engines is still comparatively small. Moreover, the internal-combustion engine is still in such an early stage of development that it is impossible to predict with certainty what the future changes will be in the type of engine used and in the structural details of vessels equipped with such engines. At present, the Diesel engine is in favor, but it may possibly happen that the vaporizer or the oil-gas or the producer-gas engine may yet be found to be superior. It is likewise uncertain whether the four-cycle, two-cycle single-acting, or the two-cycle double-acting engine will eventually become the prevailing type. The type of internal-combustion engine used, as has been explained, affects the volume of machinery and fuel spaces required; and, for different types of engines, different structural plans are followed in providing for light and air, for exhaust funnels, and for auxiliary machinery.

(3) It would be difficult, at the present time, to arrive at a general average ratio of fuel space to machinery space for internal combustion engines of different types. As the Secretary of Lloyd's Register of British and Foreign Shipping states in the letter previously quoted in this chapter, "there are comparatively few vessels which are fitted with Diesel engines, and it is therefore impossible to make a complete and exhaustive comparison between such vessels and those fitted with steam engines." If it were practicable to decide upon a ratio that was fairly accurate at present, it is not probable that that ratio would remain accurate for any considerable period of time. As has been pointed out, the fuel carried by vessels with internal-combustion engines is influenced not only by the type of engine used, but also by the number of oil stations and the price of fuel oil at different stations. It has also been pointed out that numerous varieties of oils are now used by internal-combustion engines. Future inventions may increase or lessen the number of commercially useful fuel oils. Much will depend upon the possibility of using oils with relatively low flash points, for the reason that the flash point affects the risk incurred in carrying fuel oil. In brief, there are so many factors of uncertainty

as regards the future developments of the internal-combustion engine that it seems best not to decide at the present time upon a ratio between engine-room and fuel spaces different from the Danube rule ratio to be followed in making propelling-power deductions in the case of vessels equipped with other than coal-burning steam engines.

Lloyd's Register of Shipping has thus far not provided special rules governing the spaces that may be devoted to stowing oil in vessels equipped with internal-combustion engines. The present rules of Lloyd's Society provide that "in the cases of Diesel or other engines in which very high initial pressures are employed, particulars should be submitted for special consideration." The chief engineer surveyor of the society reported in 1912 that certain regulations regarding the stowage of oil and the minimum flash point might become necessary in the future, but in the society's annual report for that year the statement is made that "it is felt that the time has hardly yet arrived for the provisions of rules on the subject." [1]

It is recognized that the application to all vessels of the same rule for propelling-power deduction will treat ships with internal-combustion engines more liberally than other vessels are treated and will make the net tonnage of vessels with internal-combustion engines somewhat less than their earning capacity. This exceptional treatment of vessels with internal-combustion engines is thought to be partially justifiable by the fact that the use of double-bottom compartments to carry fuel oil increases net tonnage and that the Danube rule, unlike the Board of Trade percentage rule, applies with equal fairness to vessels of any given type whether fuel is or is not stored in double-bottom compartments. To accord liberal propelling-power deductions to vessels equipped with internal-combustion engines while such engines are in the early stages of their development will result in but slight loss of Panama Canal revenues and may be of some assistance in bringing more promptly into the service of the world's commerce marine engines of the greatest efficiency and economy.

[1] Lloyd's Register of British and Foreign Shipping, Report of the Society's Operations, 1911–12, p. 5.

CHAPTER XI.

RULES CONCERNING SUPERSTRUCTURES AND "SHELTER" DECKS: HISTORY AND CRITICISM.

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RULES CONCERNING SUPERSTRUCTURES AND "SHELTER" DECKS: HISTORY AND CRITICISM.

INTRODUCTION.

The provisions of the several measurement rules now in force differ largely as regards the exemption, measurement, and deduction of spaces within superstructures above the uppermost full-length deck. The same is true of the spaces between the upper and so-called "shelter" deck. The treatment accorded superstructures and especially the 'tween deck, "shelter" deck spaces may largely affect the gross and net tonnage of a vessel. It is as necessary that the rules regarding the exclusion or inclusion of spaces above the upper deck should be specific and exact as that a correct rule should be followed in making deductions for propelling power. Indeed, it was made clear by the facts presented in Chapters IV and V that greater inaccuracy in tonnage may, in the case of a vessel having what the British and German rules consider to be a shelter deck, result from exempting from measurement the entire space between the upper and "shelter" deck than from applying the 32 per cent rule to the deductions made for spaces occupied by propelling power.

The term "superstructure" as used in this chapter, refers to all erections on or above the uppermost full-length deck—such as poop, forecastle, bridge houses, round houses, and side houses. By "shelter" deck spaces are meant those under an uppermost full-length deck provided with such tonnage openings as will cause the space between the "shelter" and upper decks to be exempted from measurement by the British and German rules. In the several measurement rules, the spaces under an uppermost deck with tonnage openings are sometimes spoken of as "shelter" deck spaces and sometimes as awning deck spaces. The dissimilarity in the provisions of the measurement rules as regards the inclusion or exclusion of superstructure and "shelter" deck spaces is due mainly to the different definitions given to "uppermost closed-in" deck and "open" spaces. The measurement rules of the United States, Great Britain, and Germany stipulate that spaces permanently closed-in and "available for cargo or stores or for the berthing or accommodation of passengers or crew" shall be measured, and that spaces which are open or not available for cargo or stores or for the berthing or accommodation of passengers or crew shall be exempted from measurement. The phraseology of the three measurement codes as regards the treatment to be accorded "shelter" deck spaces and the first tier of superstructures above the uppermost full-length deck is practically identical, but the rules are interpreted differently in Great Britain and Germany than in the United States, with the result that the same vessel would be accorded different gross and net tonnages by the American rules. The tonnage rules of the Suez Canal Co., like those of Great Britain, Germany, and the United States, exempt from measurement open superstructures and include in measurement and tonnage "permanently covered and closed-in spaces on the upper deck"; but the Suez rules differ in numerous details from the national rules as to the treatment of superstructures. In a word, there is great lack of uniformity among the several measurement codes as to the exclusion from tonnage, and as to the inclusion therein and deduction therefrom of spaces above the upper deck.

The rules recommended for the measurement of vessels to determine the tonnage upon which the Panama Canal tolls shall be levied adhere strictly to the principle that the gross tonnage of a vessel shall include its entire closed-in capacity. Only spaces which are actually open and not available for passengers or cargo are exempted from measurement and only such measured spaces are deducted from gross tonnage to determine net tonnage as are required for the operation and navigation of the vessel. The spaces to be deducted from gross tonnage are enumerated in the rules and the deductions from gross tonnage are to be only the enumerated spaces.

In carrying out these principles, the Panama measurement rules differ from those of Great Britain, Germany, the United States, and the Suez Canal Co. as regards the measurement and

deduction of spaces in superstructures. The spaces between the "shelter" deck and the upper deck are treated as are all other spaces, that is, if they are closed-in they are included in gross tonnage and if available for cargo or passengers they are included in net tonnage. The reasons for the variation of the Panama rules from the more important measurement rules now in force will be made clear, and it is believed the force of the reasons will also be made apparent, by a brief presentation of the history of the treatment accorded spaces under "shelter" decks and within superstructures by the measurement rules of Great Britain, the Suez Canal Co., Germany, and the United States. The historical background thus given to the rules recommended for Panama will, it is believed, show that the proposed rules are based upon correct principles and represent an advance over the tonnage rules now in effect.

HISTORY OF THE TREATMENT OF SPACES IN SUPERSTRUCTURES AND UNDER "SHELTER" DECKS IN THE MEASUREMENT RULES OF GREAT BRITAIN.

The first British statute that included within gross tonnage[1] any spaces above the upper deck was the act of 1835, which provided for the measurement of "a poop or half deck or a

[1] Rules for the measurement of vessels first appeared in laws imposing customs duties upon articles of commerce. One of the earliest imports taxed was wine from the Continent, which was imported in tuns. The dues imposed by Parliament upon each tun of wine led to the use of the word tunnage as an expression of the capacity of the open or partial-decked boats used in transporting the casks of wine. By the act of Parliament of 1423 a tun of wine was to measure not less than 252 gallons, old English measurement; and, although the gallon was not an exact unit, a tun of wine weighed approximately 2,240 pounds and the tunnage of one of these wine vessels would be practically equivalent to its deadweight capacity or tonnage. Other commodities than wine were charged dues based upon weight or "poundage."

Another article of commerce that was early taxed was coal. The act of Parliament of 1422 imposed a duty of 2 pence per caldron upon coals carried in the "keels" employed at Newcastle-on-Tyne. The caldron contained about 53 hundredweight of coal and a standard load for the "keels" then used at Newcastle was 10 caldrons, or 26½ tons. In 1679, the duty that had been imposed upon "keels" at Newcastle was placed upon vessels employed upon the Wear.

In 1694, Parliament changed the duty upon coal to a tax upon the deadweight of the coal instead of upon each caldron of coal. The coal barges or boats when empty were loaded with actual weights of iron or lead until the maximum load of 26½ tons had been placed in the boat. Then the load-water line was marked upon the boat by nails driven in the hull at the stem, at the stern, and at each side amidships. By an act of 1775, this law which had previously applied to coal carried on the Tyne and on the Wear was applied to vessels loading coal in all parts of the United Kingdom. The act applied to coal and only to boats used within the country; it did not apply to sea-going ships.

The first customs act of Parliament that required sea-going and coasting ships generally to be measured was enacted in 1694. This act imposed duties upon the tonnage of vessels and the tonnage was to be determined by multiplying the length of the keel by the breadth of the vessel amidships and by multiplying this product by the depth of the hold below the upper deck. The duties imposed by the act of 1694 were repealed in 1696. An act passed that year provided for the registry of shipping, but no rules for the measurement of vessels were contained in the act which, as far as tonnage was concerned, simply required the owners of vessels to declare upon oath the tons burden of the vessel's registry.

From 1696 until 1773 there was no general rule for the measurement of vessels applied to shipping generally. In 1720, an act was passed prohibiting the importation of spirits in vessels of less than "30 tons burden and under" and "for the preventing of disputes that may arise concerning the admeasurement of ships laden with brandy and other spirits." The law contained the following rule to be applied to the measurement of such vessels as it was necessary to measure in order to enforce the act of 1720: "Take the length of the keel within board (so much as she treads on the ground) and the breadth within board by the midship beam, from plank to plank, and half the breadth for the depth, then multiply the length by the breadth, and that product by the depth, and divide the whole by 94; the quotient will give the true contents of the tonnage."

In 1773 the formula of 1720, by which only a comparatively few vessels employed in one kind of trade had been measured, was applied in a modified form to all merchant vessels. The tonnage resulting from the application of the act of 1773 is spoken of as "British Old Measurement" (B. O. M.) tonnage. The measurement formula was as follows:

$$\text{Tonnage B. O. M.} = \frac{(L - 3/5\ B) \times B \times \frac{B}{2}}{94}$$

L in the formula is the length of the vessel along the rabbet of the keel from the back of the main stern post to a perpendicular line on the forepart of the main stem under the bowsprit. B in the formula is the breadth from the outside of the planking at the broadest part of the ship.

It will be noted that the act of 1773 substituted one-half the breadth for the depth in the factors to be multiplied together to determine the contents of a vessel. At that time the breadth was approximately twice the depth and the formula was fairly accurate. This feature of the tonnage formula of 1773, however, soon caused vessels to be built with depth disproportionate to their breadth and length and the law had a bad influence upon ship designs. In 1786 the B. O. M. tonnage formula was changed by requiring the length of the vessel to be taken not along the keel but along the load-water line, and the length of the vessel for tonnage measurement was taken from the back of the stern post to the front of the main stem with a deduction therefrom of 3 inches for each foot of the load-water draft. This deduction was to account for the rake of the stern abaft.

The only other important change made prior to 1835 in the act of 1773 was contained in the law of 1819, which provided that in measuring steam vessels the length of the engine room should be deducted from the vessel's length in calculating tonnage. This provision led to the abuse of constructing the engine-room in two parts, one well forward and the other aft, with an intervening space between the two parts of the engine-room. The distance between the forward bulkhead and the after bulkhead of the engine room thus was made to include the greater part of the length of the vessel.

The abuses that developed under the act of 1773 led to the appointment by the Admiralty of a committee to investigate the subject of tonnage in 1821. The report made by this committee was not acted upon and another committee was appointed by the Admiralty in 1833. The report of this committee led to the enactment of the law of 1835—the "new measurement" law—which provided for a much more accurate system of measurement than had previously prevailed. The depth of empty vessels was taken at three points and the breadth also at three points, and a complicated scheme of breadth and depth factors was included in the tonnage formula. The tonnage of loaded vessels was ascertained by dividing the product of the length, breadth, and depth by 130. The tonnage of the spaces in poops and under decks raised above the upper deck was ascertained by dividing the product of the mean inside length, breadth, and depth by 92.4. The tonnage allowance for engine-room space was the product of the length of the engine room between the forward and aft bulkheads, of the depth of the vessel amidships and of the breadth of the ship amidships at two-fifths the depth from the deck divided by 92.4. This "new measurement" rule remained in force until it was superseded by the Merchant Shipping Act of 1854.

For the history of British tonnage rules consult Report of Royal Commission on Tonnage, 1881, Appendixes 1 to 9, for the statutes; Lloyd's Calendar, 1911, pp. 277 et seq.; White, W. H., Manual of Naval Architecture, 5th edition, 1900, Chapter 11; Holms, Sir George C. V., Ancient and Modern Ships, Part 11, Appendix 2, 1906; The Nautical Gazette, Vol. LVIII (1889), pp. 1, 89, and 173.

break in the upper deck," and for the inclusion of the spaces thus measured in the gross tonnage. The formula by which tonnage was determined under the act of 1835—the so-called "New Measurement" law—was to multiply together the mean length, breadth, and height of measured spaces and to divide the product by 92.4.

The "New Measurement" law of 1835 proved unsatisfactory because the tonnage formula was inaccurate; and, also, because the law was so worded that excessive deductions were made for propelling power. Nor did the law take into account all superstructures. The dissatisfaction with the act of 1835 led to the appointment by the Admiralty of a tonnage commission in 1850, which, as has been explained, was in favor of a less desirable system of measurement than had been established by the act of 1835. The commission recommended a system of external measurement of vessels to determine their tonnage. This report having failed to receive the sanction of Parliament, Mr. George Moorsom worked out an accurate method of determining the cubical contents of spaces within vessels and the "Moorsom system" was incorporated in the act of 1854.

The act of 1854, which adopted Mr. Moorsom's system of measurement and stipulated that 100 cubic feet should constitute a ton, provided for the measurement of superstructures as follows:

> If there is a break, a poop, or any other permanent closed-in space on the upper deck available for cargo or stores, or for the berthing or accommodation of passengers or crew, the tonnage of such space shall be ascertained * * * and shall be added to its tonnage under the tonnage deck, ascertained as aforesaid, subject to the following provisos: First, that nothing shall be added for berthing of the crew unless such space exceeds one-twentieth of the remaining tonnage of the ship, and in case of such excess the excess only shall be added; and, secondly, that nothing shall be added in respect of any building erected for the shelter of deck passengers and approved by the Board of Trade.

The foregoing provisions of the act of 1854, and also one other section of the act, have led to controversy and to serious administrative difficulties in applying the acts of 1854 to the space between the upper deck and the one above it, usually called the "shelter" deck. The act of 1854 stipulates that—

> If the ship has a third deck, commonly called a spar deck, the tonnage of the space between it and the tonnage deck shall be ascertained * * * and shall be added to the other tonnage of the ship, ascertained as aforesaid; and if the ship has more than three decks, the tonnage of each space between decks above the tonnage deck shall be severally ascertained in manner above described and shall be added to the tonnage of the ship, ascertained as aforesaid.

If the space between the upper deck and the deck above it were permanently closed-in, it would be measured and included in gross tonnage under the provisions of the act of 1854. If, however, the space was really or, as it has turned out, technically not permanently inclosed, the space was exempted from measurement. The problems connected with the measurement, exemption, and deduction of spaces in superstructures above the uppermost deck and of spaces between the upper and "shelter" deck are different and may best be treated separately. It will be well to present first the history of the controversy regarding "shelter" deck spaces.

The Merchant Shipping Act of 1854 makes no reference to a "shelter" deck, but refers to a spar deck above the upper deck. A spar-decked ship, and also the awning-decked ship, had a definite meaning at the time of the passage of the act of 1854. They were three-decked ships having lighter scantlings and plating above than below the second deck. The space between the main deck and the awning deck, or the spar deck, was completely closed-in and was, without question, included in the gross tonnage under the act of 1854.

At various times during the 1860's, however, shipowners applied to the Board of Trade for the exemption of spaces between the upper and spar or awning decks, and during the 1870's strong pressure was exerted by shipowners to secure the exemption of 'tween-deck spaces under the awning deck. The term "awning deck" seems to have arisen in connection with the carriage of passengers in the East Indian trade and cattle in the North Atlantic trade. The spaces under the awning deck were not permanently closed-in and were entitled to exemption from measurement and gross tonnage, but gradually the space between the upper and awning deck was subdivided by numerous cross bulkheads and the sides and deck were so constructed as to make the 'tween-deck space under the awning deck practically closed against the sea. It

thus became difficult to determine whether the law required the space between the upper and awning deck to be measured or whether the space was entitled to exemption. In 1866 the Board of Trade made the proposition that spaces under a spar or awning deck, excepting those actually "included in poop, forecastle, deck house, saloons, or cabins," should be exempted from measurement, with the stipulation that exempted spaces were not to be used for freight or for the accommodation of crew or passengers, but this suggestion was not put into force, and the board took the stand that all closed-in spaces should be measured and included in the tonnage; and the bill of 1872, which was supported by the Board of Trade, provided for the inclusion in tonnage of "all covered-in spaces on any deck, except spaces covered in for the shelter of deck passengers and appropriated exclusively to their use and approved for that purpose by the Board of Trade." This bill did not become a law, nor did the bill of 1874, also supported by the Board of Trade, which contained the main provisions of the Suez Canal rules as to superstructures and 'tween-deck spaces.

The position taken by the Board of Trade was successfully opposed by the shipowners. In 1872 the Clyde Steam Navigation Co. claimed that the space between the upper deck and the awning deck of the steamship *Bear* was entitled to exemption from measurement, and the company appealed from the ruling of the Board of Trade including this space in tonnage. The awning deck of the *Bear* was its uppermost full-length deck, which was closed-in except for two openings, one forward and the other abaft the engine room. There were no permanent doors attached to these openings nor were there other means of "permanently" closing them, although there were boards and tarpaulins by which the openings might be covered as soon as the vessel got out to sea. In 1875, the case reached the House of Lords, which decided that the awning deck of the *Bear* did not constitute an upper or spar deck under the terms of the act of 1854 and that the space between awning and upper decks was entitled to exemption from measurement. The decision defined a closed-in upper or spar deck as follows:

> The kind of upper or spar deck mentioned in the act of Parliament is a continuous deck from stem to stem, fastened up and water tight, sealing up the cylinder formed between the two decks and making it a fit place for the stowage of cargo like a hold.[1]

The decision in the *Bear* case compelled the Board of Trade to alter its regulations and to consider as open the spaces under shelter decks having tonnage openings similar to those in the uppermost deck of the *Bear*, although the space between the upper and shelter deck might be used for dry cargo. In order, however, that this 'tween deck space should, when used, not be exempted from light dues and other port charges, Parliament, in 1876, amended the act of 1854 by providing for the measurement of the space occupied by cargo carried on deck or in exempted spaces. The provisions of the act of 1876 regarding deck cargoes were as follows:

> If any ship, British or foreign, other than home-trade ships, as defined by the Merchant Shipping Act, 1854, carries deck cargo, that is to say, in any uncovered space upon deck, or in any covered space not included in the cubical contents forming the ship's registered tonnage, timber, stores, or other goods, all dues payable on the ship's tonnage shall be payable as if there were added to the ship's registered tonnage the tonnage of the space occupied by such goods at the time at which such dues become payable.[2]

The enactment of the deck cargoes act of 1876 probably prevented the passage of a law amending the act of 1854 in such a way as to include so-called "shelter" deck spaces within measurement and tonnage. Parliament has sided with the shipowners in their desire to keep the tonnage of British shipping low for the purpose of lessening the charges to be borne by British shipping at home and abroad; and the fact that such portions of the "shelter" deck spaces as are actually occupied by cargo are measured and added to the space upon which shipping charges are imposed has seemed to render unnecessary the enactment of a law that would include in gross tonnage the entire closed-in capacity of vessels and in net tonnage the capacity actually available for passengers and cargo. The Royal Commission of 1881 recommended "that gross tonnage should be made to include all permanently covered and closed-in spaces above the uppermost deck; and that erections with openings either on deck, or cover-

[1] For judgment of court see Report of Royal Commission on Tonnage, 1881, p. 717.
[2] Merchant Shipping Act, 1876, 39 and 40 Vict., sec. 23.

ings, or partitions that can readily be closed-in, should also be included in gross tonnage"; but the recommendation of the Royal Commission was not adopted by Parliament; and the provisions of the act of 1854 regarding spaces between the upper deck and deek above it remain unchanged. Sinee the decision of the House of Lords in the *Bear* case in 1875, the Board of Trade has been obliged to exempt from measurement the spaces under decks provided with technical tonnage openings. In order to secure uniform praetice on the part of surveyors, the Board of Trade enforces at the present time the following regulations as to "the exemption from measurement of spaces situated above the upper deck":

The minimum width and height of the permanent openings in the bulkheads are fixed at 3 feet and 4 feet respectively, and if coamings are fitted thereto their height must not exceed 2 feet.

This rule also applies when exemption from measurement is claimed for the space between the upper and shelter decks, when such spaces are subdivided by one or more transverse bulkheads.

A single opening on one side of a bulkhead is not considered sufficient to entitle the space thus partitioned off to exemption, unless, in addition to this, there are a number of freeing ports and scuppers fitted on each side of the space claimed. In such cases, the owner's application for exemption and also a sketch of the space drawn to scale must be forwarded to the principal surveyor for tonnage for examination, and exemption must not be allowed without the board's approval. In shelter-deck cases, when the permanent deck opening is situated aft, there must be at least two openings in all the transverse bulkheads in the 'tween deck on the fore side of it to entitle the space to exemption.

As regards the dimensions of the permanent middle line opening in the shelter deck the length must not be less than 4 feet clear opening, and the width must at least be equal to that of the after cargo hatch upon the same deck. The distance between the after edge of the deck opening and the aft side of the sternpost must not be less than one-twentieth the registered length of the vessel; or if placed forward, the fore side must not be less than one-fifth the length of the vessel from the stem.

The enforcement of the Merchant Shipping Act of 1854, as regards the measurement, exemption, and deduction of spaces included within superstructures, gave rise to several distinct problems, the first of which grew out of the provisions of the act regarding crew spaces.

The law of 1854 provided for the exemption from measurement and tonnage of crew spaces up to "one-twentieth of the remaining tonnage of the ship"; and it was the practice of the Board of Trade, until 1867, to make the exemption of one-twentieth of the remaining tonnage for crew spaces and to measure and include in tonnage all crew spaces in excess of that percentage. The Merchant Shipping Act of 1867 amended the law of 1854, and stipulated that all spaces occupied by the crew wherever located were to be measured and included in gross tonnage and were to be deducted therefrom to determine net tonnage. It was provided by the act of 1867 that each seaman or apprentice should be allowed a minimum space of 72 cubic feet and of 12 superficial feet. The Board of Trade interpreted the act of 1867 as supplanting the provisions of the act of 1854 as regards crew spaces, and from 1867 to 1879 it was the practice of the Board of Trade to include all crew spaces in gross tonnage and to deduct such spaces to ascertain net tonnage. This practice of the Board of Trade, however, had to be changed in 1879, because of the decision of the High Court of Justice in the *Isabella* case.[1] The owners of the *Isabella*, the London & North Western Railway Co., it will be recalled, contended that the crew spaces on this steamer were entitled to exemption from measurement up to one-twentieth of the remaining tonnage under the act of 1854, and that the Board of Trade was required by the act of 1867 also to deduct from gross tonnage all the spaces occupied by crew. The High Court of Justice sustained the contention of the London & North Western Railway Co., and the Board of Trade was thus compelled to deduct from the gross tonnage spaces that had not been included therein. This practice was necessary for 10 years, when by the act of 1889 Parliament repealed the clauses of the Merchant Shipping Act of 1854 relating to crew spaces and specifically provided that no spaces should be deducted from gross tonnage that had not been included therein.

The acts of 1867 and of 1889, as regards crew spaces, remained unchanged until 1906, when the minimum crew space per man was increased to 120 cubic feet and to 15 superficial feet. As the law now stands, all crew spaces wherever located are measured and included in gross tonnage and are thereafter deducted in the calculation of net tonnage. The British law, unlike the Suez Canal tonnage rules, does not limit crew-space deductions to 5 per cent of the gross tonnage.

[1] Case of the *Isabella*, Apr. 3, 1879 (London & North Western Ry. Co. *v.* Wm. Fraser). See Report of Royal Commission on Tonnage, 1881, pp. 729–733.

The second difficulty encountered in the measurement of superstructures under the Merchant Shipping Act of 1854 concerned the treatment of light and air spaces above the engine room. Prior to 1879, it was the practice of the Board of Trade to measure and include in gross tonnage the light and air spaces from the crown of the engine room to the upper deck. The space thus measured was also included in the engine room. The light and air and funnel spaces framed in above the upper deck were exempted from measurement and consequently were not deducted from gross tonnage in the calculation of net tonnage. The decision of the High Court of Justice in the *Isabella* case in 1879, however, made it necessary for the Board of Trade to deduct from gross tonnage the light and air and funnel spaces above the upper deck even though those spaces had not been included in gross tonnage. This defect in the law of 1867 was remedied by the provision of the act of 1889 that no space should be deducted unless it had previously been included in gross tonnage. It was also provided by the act of 1889 that framed-in light and air and funnel spaces above the upper deck should not be measured except upon the written request of the owner of the ship. When measured upon such request, the light and air and funnel spaces above the upper deck were included in the engine room and deducted as a part of the propelling-power space, in accordance with the rules governing propelling-power deductions. The objections to the present provisions of the British measurement rules as regards light and air and funnel spaces have been considered at length in Chapters IV and V.

In applying the Merchant Shipping Act of 1854 to spaces above the upper deck, a third problem arose which involved the definition of what constituted a "permanent closed-in superstructure." The question came concretely before the Board of Trade and the Collectors of Customs in 1866 and from time to time thereafter until the position taken by the Commissioners of the Customs and by the Board of Trade was overruled by the courts in 1872 and 1873. The first case decided was that of the *Danzig*, which arose in 1872 and was decided by the courts the following year. The statement of the question involving the *Danzig* case as presented by the judge who rendered the decision is quite as interesting as the facts. The *Danzig* was a small vessel which, as constructed in 1866, had a bridge and a hurricane deck which constituted partial coverings of the upper or weather deck of the vessel. When first measured for tonnage, the spaces under the bridge and the hurricane deck so far as not inclosed into deck houses were not measured, but as the judge in the decision of the case stated:

> In 1870, a roundhouse was built for steerage passengers, and this, being measured, added about 20 tons, making the whole tonnage 480.48 tons; but still no attempt was made to measure the covered spaces under the bridge and hurricane deck. In the beginning of 1871 the pursuers constructed an additional covering over the upper deck of the vessel, extending from the after end of the forecastle, and joining with the front edge of the bridge. The custom house authorities immediately claimed that this made the whole space so covered a closed-in space in the sense of the statute, and that it fell to be measured and added to the tonnage. After some communings, this was ultimately done, and the added tonnage came to no less than 84.78 tons. It is of this addition that the pursuers complain, and to try the question the present action has been brought.

The decision of the court was that the space under the new covering was not "in the sense of the statute a break, a poop, or any permanent closed-in space on the upper deck available for cargo or stores or for the berthing or accommodation of passengers or crew" and that "the covering does not enable the ship to carry more tonnage—using the word in the sense of weight—of cargo than before but only to carry its former complement better and easier."

The facts involved in the *Windsor* case decided in 1873 were similar to those presented by the *Danzig* case and the decision of the court was again in favor of the "pursuers." These decisions of the courts compelled the Board of Trade to exempt from measurement spaces in superstructures which the Board of Trade would otherwise have considered closed-in. The present instructions of the Board of Trade to surveyors as to the measurement of permanent closed-in spaces in erections on or above the upper deck are as follows:

> In carrying out the provisions of section 77 of the Merchant Shipping Act, 1894, with respect to permanent closed-in spaces on the upper deck, the surveyors should, in determining whether or not they should be measured and added to the tonnage under the tonnage deck, have regard to the character and structural condition of such deck erections at the time when they are presented to the notice of the surveyor.
>
> Poops, bridges, or any other permanent erections with one or more openings in the sides or ends not fitted with floors or other permanently attached means of closing them, should not be measured and included in the tonnage.

In every such erection, whenever any portion of the space is occupied by timber, stores, or other goods, the tonnage of such space is ascertained and recorded by the customs in accordance with section 85 of the Merchant Shipping Act, 1894.

Poops, bridges, or any other permanent erections with one or more openings in the sides or ends not fitted with doors or other permanently attached means of closing, but otherwise so closed in as to be not only available but also actually fitted and used for the berthing or accommodation of passengers, must be measured and added to the tonnage.

The enactment of the deck cargoes act in 1876 enabled the Board of Trade to add to the tonnage upon which charges were paid such portions of exempted bridge spaces and of spaces in other deck erections as might be occupied by deck cargo, and the ability to do this probably accounts for the fact that there has been no legislation enacted to define more definitely what shall constitute closed-in spaces under the act of 1854. The report of the Royal Commission on Tonnage of 1881 recommended that "gross tonnage should be made to include all permanently covered and closed-in spaces above the uppermost deck; and that erections with openings either on deck, or coverings, or partitions that can readily be closed-in should also be included in gross tonnage"; but the recommendation was successfully opposed by the shipowners and was not made law by parliamentary act.

While hatchways are technically not superstructures, it will be well to explain how they have been treated in the administration of the act of 1854. Although hatchways came within the definition of closed-in spaces under the act of 1854, they were for some time after the passage of that law not measured because their volume was insignificant. With the increase in the size and number of hatchways, however, their volume became sufficient to cause the Board of Trade, in 1876, to issue the following instructions which are still in force:

In all new vessels and in all vessels coming in for remeasurement, the cubical contents of the hatchways are to be obtained thus: Multiply the length and breadth together and the product by the mean depth taken from the top of beam to the underside of the hatch. From the aggregate tonnage of the hatchways deduct one-half per cent of the gross tonnage, and add the remainder to the gross tonnage of the ship.

The space occupied by hatchways is included in the ship's tonnage only when, and to the extent that, the volume of the hatchways is in excess of one-half of 1 per cent of the gross tonnage of the vessel exclusive of hatchways. The "excess of hatchways" added to the ship's tonnage is thus a variable quantity affected by the rules which determine the spaces that shall be included in gross tonnage. The measurement rules of Great Britain, Germany, the United States, and the Suez Canal Co., concerning the measurement of hatchways, are identical; but the amount added to gross tonnage for hatchways in the case of any particular ship would depend upon the rules governing gross tonnage.

In applying the Merchant Shipping Act of 1854, the Board of Trade has been compelled by decisions of the courts and by acts of Parliament to make more exemptions from gross tonnage and more deductions therefrom in the calculation of net tonnage than were made under the act of 1854, as first interpreted. Attention has been called to the effect which the decisions of the courts in 1872, 1873, and 1875 had upon the measurement of spaces in superstructures and of spaces between the so-called shelter deck and the upper deck. The act of 1867 required the Board of Trade to deduct all spaces occupied by the crew; and, from 1879 to 1889, excessive deductions were necessarily made under this law. The deck cargoes act of 1876 was passed by Parliament in lieu of legislation more definitely defining what should be included in and exempted from measurement.

The law of 1889 authorizes the deduction as a part of the engine room of light and air and funnel spaces above as well as below the upper deck upon written request of the owner of the vessel. This same act of 1889 increased the deductions from gross tonnage of closed-in spaces above the deck by authorizing the deduction of (1) the space occupied by sails upon sailing vessels up to 2½ per cent of the gross tonnage; (2) spaces occupied exclusively by the master of the ship; (3) spaces used exclusively for keeping the charts, signals and other instruments of navigation and boatswains stores; and (4) the space occupied by the donkey engine and boiler if connected with the engine room of the ship, it being provided in 1889, as it had been in 1854, that the donkey engine and boiler space should be exempted from measurement if located above decks. Finally the act of 1906, by increasing the minimum space to be allotted each member of the

crew on British ships, added to the deductions authorized to be made from gross tonnage to determine net tonnage. The additional deductions authorized by the acts of 1889 and 1906 were undoubtedly justified and the laws are here referred to merely to bring out the fact that the effect of successive laws has been to increase rather than decrease the deductions provided for by the successive enactments of Parliament.

Superstructures were relatively small and their measurement was unimportant in 1854. Moreover, it was subsequent to that date that the practice arose of erecting a complete fore-and-aft deck above the upper deck. With the growth of the size of superstructures and with the increasing tendency to employ so-called shelter deck vessels in general freight service, the laws of Great Britain regarding the measurement of spaces above the upper deck and regarding deductions from gross tonnage in the case of such spaces above the upper deck have become antiquated. As now applied the act of 1854 with its amendments does not result in a gross tonnage equivalent to the entire closed-in capacity of vessels nor in a net tonnage that closely approximates the actual earning capacity of vessels.

The total exemptions of spaces above the upper deck permitted by the measurement rules of Great Britain as now enforced are enumerated in Chapter IV, but may be restated here for convenience. Summarily expressed they are as follows:

1. All superstructures which are not permanent closed-in spaces. This includes skylights and domes, companionways and all spaces of any kind which are not classed as closed-in under the rules.

2. Spaces between the "shelter" deck and the upper deck, except spaces such as are actually occupied by cargoes.

3. Closed-in superstructures solely appropriated to, and fitted with, machinery. Also the wheelhouse.

4. Deck erections for sheltering deck passengers on short voyages, if specially permitted by the Board of Trade.

5. "The cook house and bakeries when fitted with ovens and used entirely for such purposes, and the condenser space."

6. Toilets to a reasonable extent for the officers and crew; and, in the case of vessels fitted particularly for passengers, an additional toilet room may be allowed for every 50 persons; "not more than 12 are, however, generally necessary."

7. Inclosed light and air and funnel spaces above the upper deck, unless their measurement is especially requested by the owner. Such spaces must be reasonable in extent.

8. Hatchways are measured, but their volume up to one-half of 1 per cent of the gross tonnage of the vessel exclusive of hatchways is omitted from gross tonnage.

The total deductions from gross tonnage for spaces above the upper deck are stated in Chapter V. They may be summarized as follows:

1. Crew spaces with a minimum of 120 cubic feet and 15 superficial feet per man, including spaces below as well as above decks.

2. The master's cabin, when used exclusively by the master. Also engineers and officers' quarters, including berths, mess rooms, and reasonable toilet facilities.

3. Light and air and funnel spaces as part of the engine room, if requested by the owner and if they are reasonable in extent. If not requested, such spaces above the upper deck are exempted.

4. The chart room, used exclusively for charts, signals, and other instruments of navigation.

5. Space occupied by boatswain's stores.

6. The donkey engine and boiler room if connected with the engine room of the ship.

7. The sail room of a sailing vessel, up to 2½ per cent of the gross tonnage.

HISTORY OF THE TREATMENT OF SPACES IN SUPERSTRUCTURES AND UNDER "SHELTER" DECKS IN THE SUEZ MEASUREMENT RULES.

Shortly before the International Tonnage Commission met at Constantinople in 1873 to draft measurement rules to determine the tonnage upon which tolls should be paid by vessels using the Suez Canal, the United States, the Netherlands, Austria, Turkey, Denmark, Germany,

Italy, and France had adopted the gross tonnage rules contained in the British Merchant Shipping Act of 1854. Prior to 1873 the Board of Trade had enforced the provisions of the act of 1854 so as to include practically all closed-in spaces within gross tonnage. Accordingly the International Tonnage Commission at Constantinople made the provisions of the act of 1854 as regards above-deck spaces and the practice of the Board of Trade in administering that act the basis of the commission's consideration of that part of the Suez rules which concern the exemption, measurement, or deduction of above-deck spaces.

As has been explained, however, the Board of Trade had, by 1873, begun to meet with opposition to its definition of "permanent closed-in spaces" and of the "uppermost or spar deck." The *Danzig* case and the *Windsor* case had been decided by the courts in 1872 and 1873, and the *Bear* case was then pending in the courts, and the necessity for a more precise definition of closed-in spaces was evident to the British delegates at the Constantinople convention.

The rules formulated by the International Tonnage Commission at Constantinople differed from the British rules as to superstructures and above-deck spaces in three particulars. The variations from the British rules, which were brought about largely through the influence of the British delegates, included, first, an accurate definition of covered and closed-in spaces, the necessity for such a definition having been urged upon the commission by a subcommittee, which reported that "these spaces should be so defined as to preclude the possibility of the evasion of the law such as is now practiced." The rules adopted by the Constantinople Commission deviated, in the second particular, from the British rules regarding superstructures by stipulating that gross tonnage should include all inclosed spaces without any exemptions. The Suez rules, as a third variation from those in force in Great Britain, included in net tonnage various closed-in spaces which, in 1873, were, by the Board of Trade rules, either exempted from measurement or deducted from gross tonnage. The difference between the Suez and British rules as regards the exemption, measurement, and deduction of above-deck spaces has been fully explained in Chapters IV and V.

The Suez measurement rules formulated by the International Tonnage Commission in 1873 contained the provision that "gross tonnage comprehends the measurement of the whole space below the upper deck, as well as of spaces comprised within permanent constructions above that deck which are covered and closed in." [1] The rules also provided that spaces of two different classes should be deducted from gross tonnage to determine net tonnage: (1) Special deductions, spaces occupied by the propelling power of steamers, and (2) general deductions, spaces above and below deck required for the crew and for navigation purposes. As regards the second class of deductions, the report of the International Tonnage Commission explained that—

> The general deductions refer (*a*) to the accommodation of the crew (stewards and passengers' servants are not to be considered as part of the crew); (*b*) to officers' cabins (the captain's not included therein); (*c*) to cook houses and closets exclusively for the use of the crew, situated either above or below the upper deck; and (*d*) to covered and closed-in spaces, if there are any on the upper deck, employed for working the ship. These spaces are to be measured separately, and the sum of them deducted. The sum total of these deductions is, however, in no case to exceed 5 per cent of the gross tonnage, but this percentage may be distributed among the several spaces according to the practice and requirements of different countries. Besides the above-named spaces, it was proposed in the commission to deduct, further, spaces occupied by the captain's cabin, the sail room, and other places used for stowing ropes and other gear, but these latter deductions were not approved by an absolute majority of votes.

[1] The Suez rules as to what gross tonnage shall include and as to the measurement of superstructures and "shelter" decks as formulated by the International Tonnage Commission in 1873 were as follows. These rules, supplemented by the regulations of 1904, are still in force.

"The gross tonnage or total capacity of ships comprises the exact measurement of all spaces (without any exception) below the upper deck, as well as of all permanently covered and closed-in spaces on that deck.

"By permanently covered and closed-in spaces on the upper deck are to be understood all those which are separated off by decks or coverings, or fixed partitions, and therefore represent an increase of capacity which might be used for the stowage of merchandise, or for the berthing or accommodation of the passengers or of the officers and crew. Thus, any one or more openings, either in the deck or coverings, or in the partitions, or a break in the deck, or the absence of a portion of the partition, will not prevent such spaces being comprised in the gross tonnage, if they can be easily closed-in after admeasurement, and thus better fitted for the transport of goods and passengers.

"But the spaces under awning decks without other connections with the body of the ship than the props necessary for supporting them, which are not spaces, 'separated off,' and are permanently exposed to the weather and the sea, will not be comprised in the gross tonnage, although they may serve to shelter the ship's crew, the deck passengers, and even merchandise known as 'deck loads.'

"'Deck loads' are not comprised in the measurement.

"Closed spaces for the use or possible use of passengers will not be deducted from the gross tonnage."

In many particulars the Suez rules regarding the measurement of spaces constructed above the upper deck are practically the same as the British rules. The Suez, like the British, rules provide that "if there be a break, a poop, or any other permanent closed-in space on the upper deck available for cargo or stores or for the berthing or accommodation of passengers or crew, the tonnage of such a space shall be ascertained." The application of this provision, however, under the Suez rules is made more specific than under the British, because the Suez rules stipulate that all closed-in spaces shall be measured, and not merely those "available for cargo or stores or for the berthing or accommodation of passengers or crew." The definition contained in the Suez rules, moreover, stipulates that a space is permanently closed-in not only when permanent coverings are provided for closing the openings to the space, but also when the openings "can be easily closed-in after admeasurement." A space is considered closed-in under the Suez rules not only when it is actually used to stow freight or accommodate passengers or crew, but also when it "might be used" for those purposes.

The Suez rules, furthermore, contain the clause that "if the ship has a third deck, commonly called a spar deck, the tonnage of the spaces between it and the tonnage deck shall be ascertained"; and this provision is made definite and specific by the definition of what shall constitute a covered and closed-in space as well as by the stipulation in the rules regarding spaces under an awning deck. The definition accompanying the rules stipulates that any deck spaces that are not "separated off" and are "permanently exposed to weather and sea," and have no other "connection with the body of the ship than props necessary for supporting them," shall be treated as open spaces and exempted from measurement; but the spaces which do not fulfill these conditions are considered as covered and closed-in and are thus included within the tonnage.

In making deductions from gross tonnage under the Suez rules, as they were originally applied, no light and air and funnel spaces above the upper deck were included in the engine room in case the Danube rule was followed in calculating propelling-power space. In case of vessels with fixed bunkers, however, if the shipowner selected the actual measurement rule for propelling-power deduction, the light and air and funnel spaces in the covered and closed-in erections on the upper deck were included in the engine room and deducted from the gross tonnage. Inasmuch as the Danube rule was applied to most ships, there was but little actual deduction of light and air and funnel spaces above the upper deck.

The principle of deducting all spaces not available for cargo or passengers was not carried out with entire consistency. There were various closed-in spaces above decks that were not available for that purpose, but were nevertheless included in the net tonnage—the master's cabin, spaces occupied by the ship's purser and clerk, boatswain's storeroom, sail room on sailing vessels, inclosed light and air and funnel spaces in case the Danube rule is applied, hatchways, skylights and domes, and companionways. Some of these spaces were referred to in the deliberations of the International Tonnage Commisson of 1873, but the spaces were not deducted for the reason that it was felt that the Moorsom ton of 100 cubic feet was such a liberal unit upon which to base tolls as to compensate for the spaces not deducted.

In the administration of the measurement rules as formulated by the International Tonnage Commission, questions of interpretation have arisen from time to time. Vessel designs have changed greatly since 1873. There was, as has been noted, a tendency in most national measurement rules to increase exemptions and deductions for the purpose of making the net tonnage small and, thus, the dues on shipping light. Naturally, shipowners have sought similar favors from the Suez Canal Co., and the original Constantinople rules have undergone some "evolution."

The shipowners were able to profit by the fact, or by the temporarily effective claim, that definitions in the Suez rules covering closed-in spaces and open spaces did not include all spaces. It was the intent of the International Tonnage Commission that these definitions should so supplement each other as to place the meaning of closed-in and open spaces beyond quibble; but it was claimed by shipowners that there were certain spaces that were not covered by either definition and that were thus exempt from measurement. The first concession as to above-

deck spaces that was made by the canal company in response to the pressure of the British Government, which took up the claims of the British shipowners, was made in 1878, when the company agreed to exempt skylights and domes, companionways not used as smoking rooms, and hatchways to the extent of one-half of 1 per cent of the gross tonnage. The concession was unimportant except that the canal company thereby opened the door to further demands by shipowners, and precipitated a general controversy over closed-in spaces.

For a while the British Board of Trade attempted to maintain the position that any government which had participated in the negotiations at Constantinople in 1873 could interpret the Suez measurement rules as it saw fit, without regard to the opinion of the canal company. It would obviously have destroyed the rules had each country been allowed to place its own interpretation upon the rules; indeed, the British Board of Trade recognized the truth of this when, in 1897, it complained that the interpretation of the rules by Holland in the case of 11 Dutch ships was incorrect. The Suez company has at all times claimed the right to interpret its measurement rules; but for a while the claim by the several governments of the right to interpret the rules made complete uniformity of practice in the application of the rules impossible. About 1890 the tendency to erect numerous superstructures became marked, and before long it became necessary for the canal company to come to an understanding with the several national measurement authorities.

An arrangement, never formally sanctioned by the company, was agreed to by its operating department in 1899 upon the advice of Sir John Stokes, who had been a British delegate at Constantinople, and who was now a representative of the British Government in the Council of Administration of the Suez Canal Co. The regulation provided that spaces declared open under the national measurement rules of Great Britain would not be measured unless they were actually used to stow freight. This regulation, however, violated the fundamental principle that Suez tolls should be levied on usable capacity and not on capacity actually in use, and it led to such flagrant evasions of the rules on the part of shipowners that in 1902 Sir John Stokes brought about its abandonment.

The new regulations adopted by the company in 1902 reestablished the principle that usable capacity should be the basis of tolls, but the company was obliged to make certain concessions. The company agreed to exempt such portions of spaces under "shelter" decks as lie opposite side openings. Moreover, if there were spaces in isolated superstructures which the British rules considered open, the owner of the vessel was to declare the use he intended to make of the space. If he declared that no freight or passengers were to be carried in the space it was to be exempted under the Suez regulations, otherwise it was to be measured. The Suez rules, however, stipulated that if use was made at any time of an exempted space, the space was thereafter to be included in net tonnage.

The concessions made by the Suez Canal Co. in the regulations of 1902 did not work satisfactorily in practice. Within a short time numerous ships presented themselves at the canal with tonnage certificates that had exempted large spaces which the owners of the vessels had declared they did not expect to use, but which, as a matter of fact, they were using. The temptation to make false declarations was too great for the shipowners to withstand.

The regulations promulgated in 1902 were superseded, in 1904, by new rules regarding spaces in superstructures and under shelter decks. The memorandum containing the changes made in 1904 is printed in full in Appendix XII to this report. Under the arrangement of 1904, the spaces under "shelter" decks in way of opposite openings in the side plating of the ship not provided with coverings are exempted from measurement; but all the remaining portions of the spaces under the "shelter" deck are to be measured. The regulations of 1904 contain specific rules for the measurement of superstructures or spaces in superstructures which are considered open by the measurement rules in force in various countries, but which are considered to be closed-in under the original Suez rules.[1] One important provision of the regulations of 1902 was retained in the special rules of 1904. This was the provision that "should a vessel, at any time, transit with merchandise of any kind or bunker coal or stores of any descrip-

[1] For the full text of these special rules consult Appendix XII.

tion, in any portion whatever of an exempted space, the whole of that space is added to the net tonnage and can nevermore be exempted from measurement."

The deductions from measured spaces above the upper deck now permitted under the Suez rules are, with one exception, the same as those deductions were when the rules were first promulgated. The memorandum of 1904 (see Appendix XII) supplemented and explained the original rules, but provided for only one deduction that had not previously been authorized. The change made in 1904 concerned the treatment of light and air and funnel spaces above the engine room. The original Danube rule for propelling-power deductions had included in the engine room light and air and funnel spaces only up to to the upper deck, but the regulations of 1904 included in the engine room light and air and funnel spaces between the upper deck and the "shelter" deck; and, if the owner of the vessel agrees to forego certain exemptions to which he would otherwise be entitled, the light and air and funnel spaces within inclosed superstructures extending above the uppermost deck may also be included in the engine-room space.

The original Suez rules exempted from measurement only open spaces. All covered and closed-in spaces on the upper deck were included in the measurement of tonnage, but the original rules have been supplemented in the manner indicated in the preceding pages, so that at the present time several covered and closed-in spaces above the deck are exempted from measurement. The spaces thus exempted are:

1. Skylights, companionways not used as a smoking room, and hatches up to one-half of 1 per cent of the gross tonnage exclusive of hatchways.

2. The portions of "shelter" deck spaces directly in way of opposite openings in the side plating of the ship—the openings not being provided with means of closing.

3. Certain portions of superstructures which are closed in according to the original Suez rules, but are open according to the national measurement rules of the country in which the vessel is registered.

4. When propelling-power deduction is made by the Danube rule, the light and air and funnel spaces exempted are those above the upper deck unless the vessel has a "shelter" deck, in which case the spaces exempted are those above the "shelter" deck. (The regulations of 1904, as explained above, permit the shipowner to have light and air and funnel spaces within inclosed superstructures above the uppermost deck measured and included in the engine room, if the shipowner agrees to forego certain stipulated exemptions.)

The shipowners of Great Britain, who had been successful in obtaining a modification and a liberal interpretation of the British measurement rules, were mainly responsible for the changes that have been made in the Suez rules. However, the Suez rules, having been formulated by an international commission and administered by a private company, have not been much changed as a result of the pressure of the shipping interests. Though modified in certain respects, the Suez rules are in the main as they were in 1873. While the treatment of spaces within superstructures and under "shelter" decks, in the national measurement rules of Great Britain and other countries, has been greatly changed, the provisions of the Suez rules as regards the exemption, measurement, or deduction of those spaces have remained fairly constant and consistent.

HISTORY OF THE TREATMENT OF SPACES IN SUPERSTRUCTURES AND UNDER "SHELTER" DECKS IN THE GERMAN RULES.

The measurement rules of Germany are to-day nearly the same as those of Great Britain. For a while after 1873 it was thought that the rules framed at Constantinople by the International Tonnage Commission would be generally adopted by the several countries; but, as has been explained, the refusal of Great Britain in 1874 and again in 1881 to adopt the Suez rules caused Germany ultimately to conform its measurement rules to those of Great Britain.

Prior to January 1, 1873, the several German States did not have a uniform method of determining the tonnage of vessels. In Prussia under the act of February 15, 1862, in Bremen by the act of March 12, 1860, and in Luebeck in accordance with the act of June 30, 1850, the unit of tonnage was the "last" or weight of 4,000 pounds, and the unit of measurement was the "Rhenish" foot. Closed-in superstructures, formed by partial decks erected above the upper

deck, such as forecastles, poops, and bridges, were included in the gross tonnage—the calculation of their contents being made by applying the formula, length times breadth times height divided by 116 equals tonnage. Other covered and closed-in spaces above the upper deck available for the use of passengers or merchandise were measured according to the formula, length times breadth times height divided by 232 equals tonnage. Crew spaces above the upper deck were in each case exempted from measurement. At Hamburg, under an old tonnage statute of 1819, the unit of tonnage was a "last" of 6,000 pounds, and the unit of measurement was the Hamburg foot. No superstructures or spaces under "shelter" decks were included in the tonnage of any vessel.

Substantial uniformity in tonnage rules was established in Germany by the Imperial Statute of July 5, 1872, which adopted the Moorsom system for measuring vessel spaces and which accorded superstructures and shelter decks the treatment given such spaces by the British Board of Trade before the decision of the House of Lords in the *Bear* case in 1875. An official circular of the German Government, issued June 3, 1873, stipulated that under the law of 1872 the following above-deck spaces were to be exempted from measurement:

(1) Such hatchways, hoods, light and air passages, partitions over hatchways, or passages leading to cabins or spaces below decks as are intended neither for keeping goods or provisions nor for the lodging or permanent abode of passengers or persons belonging to the crew; (2) spaces that are open or not closed on one or more sides; (3) spaces that are used solely for navigating the vessel or for keeping implements used for that purpose; and (4) spaces that may be used as galleys or as privies for passengers or the crew, provided that their number and size do not exceed what is usual, and that there is no ground for the supposition that they are to be used as lodging places for persons or as receptacles for goods or provisions.

The circular of June 3, 1873, also provided that crew spaces should be measured and then deducted, the maximum deduction allowed being 5 per cent of the gross tonnage.

An ordinance of the Imperial Government of June 20, 1888, supplemented the earlier laws by definitely including, in measurement, light and air and funnel spaces above the engine room, which increase the efficiency of the ship's machinery, and the contents of cargo hatches directly connected with cargo holds, to the extent that the space taken up by the hatches exceeded one-half of 1 per cent of the gross tonnage.

The present measurement rules of Germany were adopted March 1, 1895. As amended in 1899, 1901, 1905, 1906, 1907, and 1908, the ordinance of 1895 provides for the measurement of—

(1) Any space between the tonnage deck and a "deck above the tonnage deck," and "if the ship has more than three decks, the spaces between decks located over the tonnage deck"; (2) "the space occupied by all covered and inclosed superstructures permanently erected on or above the first deck which are inclosed by substantial bulkheads and coverings, suitable for storage of freight or merchandise, or for quarters or other accommodations of the crew and passengers"; and (3) hatches in excess of one-half of 1 per cent of the gross tonnage.

The following above-deck spaces are specifically exempted by law:

(*a*) All covered and inclosed spaces which are used exclusively for the operation of the auxiliary machinery, and also the pilot house for the protection of the men at the steering wheel, provided these spaces are not larger than necessary for the purpose specified; (*b*) each structure necessary on short voyages for the protection of deck passengers against storm and waves, if the measurement board is authorized to exempt it by the Bureau of Registry; (*c*) the kitchen (galley) and the place for the distilling apparatus, provided they are not larger than actually necessary for the preparing of meals, at the same time affording sufficient shelter to the machinist while distilling water for the passengers and the crew (see Appendix VII to this report, "Technical Directions," Art. III); (*d*) toilets for the officers and crew of the ship, provided they do not exceed the proper number and size.

The foregoing provisions of the German ordinance as to the measurement and exemption of spaces in superstructures are practically the same as those in force in Great Britain. Moreover, in the treatment of spaces under a "shelter" deck, the only significant difference between the British and German rules is the absence of a deck-cargoes act in Germany. When German

surveyors are in doubt whether a space under a "shelter" deck is open or closed-in, they must decide either to measure or to exempt the entire space. If the British surveyors decide that a "shelter" deck has the requisite "tonnage openings," they may measure the spaces under the "shelter" deck actually occupied by cargo and exempt the remainder of the space.

The provisions of the German ordinance of 1895, as amended, regarding deductions of spaces above deck are practically identical with corresponding provisions of the British measurement statute. A slight difference between the British and German regulations as to deductions results from the somewhat more liberal minimum requirements for crew spaces in Great Britain and also from a slightly different practice regarding deductions for passageways. In Great Britain passageways are deducted when they serve deducted spaces exclusively, whereas in Germany passageways are deducted only if they serve crew and officers' quarters exclusively.

The interpretation of the rules regarding superstructures and spaces under "shelter" decks by the Imperial Bureau of Registry and by the State Measurement Boards of Germany is also practically the same as the meaning given those rules by the Board of Trade in Great Britain. The "Technical Directions" to German surveyors to guide them in the measurement of closed-in and open spaces under shelter decks and in superstructures (see Appendix VII, pp. 347 to 354) are more detailed than the official instructions of the Board of Trade to British surveyors; but as applied in actual practice the German directions produce the same tonnage results as do the British instructions. There is indeed very little difference between the measurement rules and practices of Great Britain and Germany as regards the measurement and deduction of spaces to determine net tonnage for registry. Originally the German rules were different from the British. In 1890, before the present ship measurement ordinance of Germany had been enacted, the deduction from gross tonnage to obtain net tonnage averaged 31 per cent for the entire German merchant marine, as compared with 37 per cent in Great Britain. Since the German ordinance of 1895 has been in effect the percentage of deduction in the two countries has been practically the same. In 1900 the deduction was 37 per cent in Germany and 38 per cent in Great Britain, and in 1910 it was 39 per cent in both countries.

Although the rules for determining net tonnage are practically the same in Great Britain and Germany, vessels under the German flag have some advantage over those under the British flag because of the fact that there is no deck-cargoes act in Germany. In neither country are spaces occupied by deck loads included in registered tonnage, but such spaces are measured in Great Britain and their volume is added to the tonnage upon which taxes and dues are paid. Under the German rules a space is either closed-in or open, as determined by the technical directions issued by the Bureau of Registry; deck loads on uncovered decks or within "open" deck erections are not measured.

HISTORY OF THE TREATMENT OF SPACES IN SUPERSTRUCTURES AND UNDER "SHELTER" DECKS IN THE UNITED STATES RULES.

The early tonnage laws of the United States, like those of Great Britain, aimed to ascertain the dead-weight capacity of vessels; and, as the space occupied by superstructures and by above-deck constructions was small, the statutes took no account of erections above the upper deck. When the first tonnage law of the United States was enacted, September 1, 1789, the standard types of ships were vessels with but one or two decks; and the law provided for the measurement only of single and double decked ships, no mention being made of vessels with more than two decks nor of the measurement of any superstructures whatsoever. This law of 1789 was reenacted March 2, 1799, as a part of the general tonnage tax collection act. It remained in force until 1864.[1]

[1] The provisions of the acts of 1789 and 1799 were as follows:

"That to ascertain the tonnage of any ship, the surveyor or such other person as shall be appointed by the collector of the district to measure the same shall, if the said ship or vessel be double-decked, take the length thereof from the forepart of the main stem, to the afterpart of the stern post, above the upper deck, the breadth thereof at the broadest part above the main wales, half of which breadth shall be accounted the depth of such a vessel, and shall then deduct from the length three-fifths of the breadth, multiply the remainder by the breadth and the product by the depth, and shall divide this last product by 95, the quotient whereof shall be deemed the true contents or tonnage of such ship or vessel. And if such ship or vessel be single decked, the said surveyor or other person shall take the length and breadth as above directed, in respect to a double decked ship or vessel, shall deduct from the said length three-fifths of the breadth, and taking the depth from the underside of the deck plank to the ceiling in the hold, shall multiply and divide, as aforesaid, and the quotient shall be deemed the tonnage of such ship or vessel." (U. S. Stat. L., vol. 1, p. 55, Sept. 1, 1789, and p. 676, Mar. 2, 1799.)

By the tonnage acts of 1789 and 1799, the tonnage of double-decked vessels was determined by applying the formula, length minus three-fifths breadth times breadth times one-half breadth divided by 95 equals tonnage. With the exception that the divisor was 95 instead of 94, this formula was the same as that of the Builders' Old Measurement Law which was in force in Great Britain from 1775 to 1835, and which continued to be privately used for some years thereafter. For a single-decked vessel, the formula of the acts of 1789 and 1799 was, length minus three-fifths breadth times breadth times depth divided by 95 equals tonnage.

The gross tonnage rules now in force in the United States are based on the provisions of the statute of May 6, 1864,[1] which adopted the Moorsom system of measuring vessel spaces. The clauses of the act of 1864 relating to the measurement of superstructures and of 'tween deck spaces above the upper deck were practically the same as the corresponding clauses in the British Merchant Shipping Act of 1854, viz: "If there is a break, a poop, or any other permanent closed-in space on the upper deck, or on the spar deck, available for cargo, or stores, or for the berthing or accommodation of passengers or crew, the tonnage of such space shall be ascertained," and, "if the vessel has a third deck, or spar deck, the tonnage of the space between it and the tonnage deck shall be ascertained." The United States statute of 1864, however, provided for no deductions from gross tonnage of any measured spaces, because gross tonnage and not net tonnage was made the basis of tonnage taxes and other charges on shipping. It was not until 18 years later that Congress made net tonnage the basis of charges.

The treatment accorded superstructures and 'tween-deck spaces above the upper deck by the act of 1864, so far as their gross tonnage was concerned, was with one important exception the same as was accorded such spaces by the regulations of the British Board of Trade prior to the decision in the *Bear* case in 1875. The exception was due to an amendment of the act of 1864, which Congress made on February 28, 1865,[2] and which provided that "no part of any ship or vessel shall be measured or registered for tonnage that is used for cabins or staterooms and constructed entirely above the first deck, which is not a deck to the hull." By this amendment spaces above the first tier of superstructures, if used for cabins or staterooms, were exempted from measurement. This clause of the act of 1865, it seems, was intended to apply only to "cabins or staterooms above the 'promenade' deck of the steamers of the seacoast and lakes, or above a 'boiler' deck as used on the western rivers," [3] and for a while the act was applied only to river and lake steamers. Later, however, the statute, not having been limited to any particular class of ships, was held to exempt from measurement all but the lowest of the tiers of superstructures on ocean passenger steamers, the largest of which have now come to have several passenger decks above the uppermost full-length deck. Thus applied, the act of 1865 exempts from tonnage large revenue-earning spaces on typical passenger steamers. The tonnage rules of the Suez Canal Co. and of Germany, as well as those of Great Britain, include in the measurement and tonnage the spaces occupied by passengers in all tiers of superstructures. The exemption clause of the United States act of 1865 should have been repealed long ago.

In 1882 Congress, acting favorably upon the report of a committee of the House of Representatives,[4] made net tonnage the basis of tonnage taxes. The tonnage act of August 5, 1882,[5] authorized the deduction of propelling-power spaces, according to the Danube rule, up to 50 per cent of the gross tonnage, and the deduction of crew spaces up to 5 per cent of the gross tonnage. The only above-deck spaces deducted from gross tonnage by the act of 1882 were crew spaces, and the total deductions for crew spaces, above as well as below decks, could not exceed 5 per cent of the gross tonnage.

The allowable deductions of above-deck spaces from gross tonnage were increased by the act of March 2, 1895. It was this law, also, that substituted the British Board of Trade rule for deducting propelling-power spaces for the Danube rule. The changes made by the act of 1895 were intended to bring the American tonnage rules into more substantial accord with those of

[1] U. S. Stat. L., vol. 13, p. 69, May 6, 1864.
[2] U. S. Stat. L., vol. 13, p. 444, Feb. 28, 1865.
[3] Customs Regulations of the United States (1908), p. 53.
[4] H. Rep. 1228, 47th Cong., 1st sess. (1882).
[5] U. S. Stat. L., vol. 22, p. 300, Aug. 5, 1882.

Great Britain and other countries. As the House committee stated in its report upon which the bill was based: [1]

> The purpose of the bill is to meet a situation created by the diversity of methods of ascertaining net tonnage employed by maritime nations. The net tonnage of vessels under American laws is greater than the net tonnage of the same dimension and description under the foreign laws. Net tonnage is the basis of various navigation dues, port charges, etc. Consequently in foreign ports our vessels are required either to pay higher port charges than foreign vessels of like dimension and description, or subject themselves to the delay and excuse of remeasurement in foreign ports. Usually they accept the former alternative. * * * The bill is designed to accommodate and reduce expenses of American vessels in foreign trade.

The act of 1895 authorized the following deductions of above-deck spaces from gross tonnage:

(1) Crew spaces wherever located, without any maximum limit, and with a minimum limit of 72 cubic feet and 12 superficial feet per man. These were the minima enforced in Great Britain until they were increased by the Merchant Shipping Act of 1906. By act of March 3, 1897, the American minimum limit on seagoing sailing vessels was increased to 100 cubic feet and 16 superficial feet for vessels built or rebuilt after June 30, 1898. (2) The master's cabin. (3) Spaces used exclusively for keeping the charts, signals, and other instruments of navigation and boatswain's stores. (4) Space occupied by the donkey engine room and boiler, if connected with the engine room of the ship. (5) The space used for storing sails on sailing vessels up to one-half of 1 per cent of the gross tonnage. And (6) light and air and funnel spaces in inclosed structures above the engine room may, upon written request of the shipowner, be included in the gross tonnage and deducted as part of the engine room and bunker allowances.

The exemptions from gross tonnage were not changed by the act of 1895, but by the act of February 6, 1909, hatchways were exempted from measurement up to one-half of 1 per cent of the gross tonnage.

The act of 1895, however, has not succeeded in bringing the American and British treatment of superstructures into entire accord. The deduction of above-deck spaces from gross tonnage is now substantially the same in the United States as in Great Britain and Germany, but there are differences in exemptions from measurement. The only difference in this regard in the tonnage laws is the exemption in the United States, under act of February 28, 1865, of "cabins and staterooms constructed above the first deck, which is not a deck to the hull." A deck to the hull is defined by our measurement authorities as any deck "which has a direct bearing upon the frame timbers, even though lighter than other decks in the same vessel, and though only a portion of the timbers extend to such deck. In iron vessels an upper deck supported by stanchions of wood or iron bolted to the angle irons or to the iron plating of the vessel is to be taken as a deck to the hull." [2] Although this definition seems definite, many spaces above the first tier of superstructures on large passenger steamers, which are measured under the rules of Great Britain, Germany, and the Suez Canal Co., are in practice exempted in the United States.

The differences in the practices as to the exemption of spaces in superstructures and under "shelter" decks are dependent less upon dissimilarities in statutory provisions than upon the varying interpretations given "permanent closed-in" and "open" spaces. The wording of the statutes of the United States, Germany, and Great Britain in regard to these exemptions are identical, but the application of the rules is such that the average net tonnage of American ships is in excess of the average net tonnage of vessels registered in Great Britain and Germany.

The meaning given to "open" and "closed-in" spaces by American surveyors not having been controlled by the decision of the British courts in the *Bear* case, and not having been influenced by a deck-cargoes act, the American rules as to the measurement or exemption of spaces above the upper deck are much the same as they originally were and as the British rules were prior to 1875. The Customs Regulations of the United States now define closed-in spaces as follows: [3]

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[1] H. Rept. 1515, 53d Cong., 3d sess. (1894).

[2] Customs Regulations of the United States, edition of 1908, p. 53.

[3] For the complete Rules and Regulations of the United States Concerning the Measurement of Vessels, see Appendix II.

By "closed-in spaces" is to be understood spaces which are sheltered from the action of the sea and weather, even though openings be left in the inclosure. Measuring officers will exercise due vigilance that the intent of the law in this respect is not evaded. It should be borne in mind, however, that no closed-in spaces above the upper deck to the hull are to be admeasured unless available for cargo or stores or the berthing or accommodation of passengers or crew. The engine room, pilot house, galley, windlass house, and the like, are, when so situated and used, exempt.

Whether for the purpose of measurement a deck is to be regarded as an upper deck or as the shelter deck is to be determined in each instance both by the character and structural conditions of the erection, and by the purpose to which the between-deck is devoted. Differences in construction are so numerous that no definition or rule on this subject has been formulated. If the deck is a continuous deck, fastened down and water-tight, sealing up the cylinder formed between the two decks and making it a fit place for the stowage of cargo, like a hold, the deck is to be treated as an upper deck and the space between it and the deck below is to be measured. If, however, the cylinder is open to the shipment of seas, and the space is not reasonably fit for the carrying of dry cargo, but is used only for cargo generally classed as deck cargo, such as cattle, horses, chemicals, oil in barrels, etc., then, usually, the deck is to be regarded as a shelter deck, and the space as "sheltered space above the upper deck which is under cover and open to the weather: that is, not enclosed," and not to be included in the recorded tonnage.

Inasmuch as the measurement or exemption of superstructures and of spaces under "shelter" decks must depend upon the judgment of individual surveyors as to whether spaces are "closed-in" or "open," it is necessary for the measurement authorities of all countries to issue specific regulations to be followed by admeasurers. The admeasurers at New York are guided by the following interpretation given by the Surveyor of the Port to the "Customs Regulations of the United States:"

1. *Closed-in spaces above the upper deck.*—If there be a break, poop, bridge, forecastle, deck house, hatchway, or any other permanent closed-in space above the upper deck, available for cargo or stores, or for the berthing or accommodation of passengers or crew, the tonnage of that space shall be ascertained and added to the gross tonnage.

2. *Closed-in spaces.*—By closed-in spaces is to be understood spaces which are sheltered from the action of the sea and weather, even though openings be left in the inclosure. Forecastles, bridges, poops, or any other permanent erection with one or more openings in the sides or ends fitted with doors or other permanently attached means of closing them should be measured and included in the gross tonnage.

3. *Openings in bulkheads.*—When an opening in the bulkhead of a deck erection is closed, either by a hinged door, or by a portable plate which is secured in place by nut and screw bolts so as to be water-tight, the opening may be regarded as completely closed.

4. *Openings in front of bridge house or poop.*—When there is an opening or openings in the bulkhead at the front of a bridge house or poop closed by hinged doors or by shifting boards when fitted into channel bars, which extend the full height of the opening, the space may be regarded as closed.

5. *Openings in after end of bridge house or forecastle.*—When there are openings in the bulkhead at the after end of a bridge house or forecastle, closed by portable plates secured in place by nut and screw bolts or closed by shifting boards, when fitted into channel bars which extend the full height of the openings, the space may be regarded as completely closed.

6. *Open spaces.*—Spaces under awning decks without other connection with the body of the ship than the stanchions necessary for supporting them, which are not spaces separated off and are permanently exposed to the weather and the sea, will not be comprised in the gross tonnage.

7. *Exempted spaces.*—It should be borne in mind, however, that no closed-in spaces above the upper deck to the hull are to be admeasured unless available for cargo or stores or the berthing or accommodation of passengers or crew. The engine room, pilot house, galley, windlass house, and the like are, when so situated and used, exempt.

8. *Cabin and staterooms in superstructures above lowest tier.*—No part of any vessel will be admeasured or registered for tonnage that is used for cabins or staterooms and constructed entirely above the first deck which is not a deck to the hull.

9. *A deck to the hull.*—Any deck is a deck to the hull which has a direct bearing upon the frame timbers, even though lighter than other decks in the same vessel, and though only a portion of the timbers extend to such deck. In iron vessels an upper deck supported by stanchions of wood or iron bolted to the angle irons or to the iron plating of the vessel is to be taken as a deck to the hull. In consequence of the diversity of modes of construction much in this particular must necessarily be confided to the judgment of the measuring officer.[1]

With the exception of the exemption from measurement of cabins and staterooms constructed above the first deck which is not a deck to the hull, the American treatment of superstructures and of spaces under "shelter" decks corresponds more closely to the practice of the

[1] These instructions are quoted from a letter received from the Surveyor of the Port of New York, Nov. 13, 1912.

Suez Canal Co. than to that followed in Great Britain or Germany. The differences between the Suez and American practice are as follows:

(1) The Suez rules include in the gross tonnage of vessels closed-in spaces used for navigation purposes, later deducting some of the spaces to ascertain net tonnage, while the American rules exempt from measurement navigation spaces not available for freight, stores, crew, or passengers. This difference in practice does not greatly affect the final tonnage result, but certain spaces which are exempted or deducted in the United States are neither exempted nor deducted under the Suez rules. Such spaces are the master's cabin, the rooms occupied by the ship's purser and clerk, spaces used for the boatswain's stores, for the donkey engine and boiler if used to hoist cargo, and for storing the sails on sailing vessels. The treatment of light and air and funnel spaces is also somewhat different in the Suez and American rules. In the United States, such spaces located above the upper deck in inclosed erection may, upon special request, be deducted as part of the engine room, while under the Suez rules the shipowner may not request such deduction without forfeiting certain exemptions specified in the memorandum issued by the Suez Canal Co. in 1904.

(2) The Suez rules limit the entire volume of deductions for crew and navigation spaces to 5 per cent of the gross tonnage, while the United States prescribes no maximum limit.

(3) The definition of shelter decks is similar, but since 1902 the Suez rules have exempted spaces lying directly in way of opposite non-closable openings in the sides, while in the United States rules there is no such provision.

(4) The Suez and American definitions of closed-in and open superstructures are similar, but since 1904 the Suez rules exempt certain portions of such superstructures as are "closed-in" according to the Suez definition, but "open" according to the definition prevailing in the home country of any particular vessel.

(5) The American rules do not contain the provision that an exempted place once found to contain dry cargo shall always thereafter be included in the vessel's tonnage. In practice, however, this difference is slight, for the presence of dry cargo in an exempted space causes the American admeasurers to include in the tonnage all spaces in which cargo is found.

For convenience of comparison, the provisions relating to the exemption and measurement of superstructures and 'tween-deck spaces above the upper deck in the measurement rules of the United Kingdom, the Suez Canal Co., Germany, and the United States are stated in parallel columns in Table XII:

TABLE XII.—*Treatment (in 1913) of superstructures and shelter-deck spaces under the measurement rules of Great Britain, the Suez Canal Co., Germany, and the United States.*

Portion of vessel.	United Kingdom.	Suez Canal.	Germany.	United States.
Forecastle	Measured if "closed-in" and available for cargo, passengers, crew, or stores; exempted if "open" or not available for cargo, passengers, crew, or stores.	Measured if "closed-in" under national and Suez rules; partly exempted if "open" under national rules but closed-in under Suez rules. Suez definition of "closed-in" spaces stricter than in United Kingdom and Germany.	Same as United Kingdom.	Same as United Kingdom, but with stricter definition of "closed-in."
Poop or break	do	do	do	Do.
Bridge space	do	do	do	Do.
Side houses	do	Measured if "closed-in" under Suez rules.	do	Do.
Deck houses	do	do	do	Do.
Spaces for anchor gear, steering gear, and capstan.	Exempted	Measured	Exempted	Exempted.
Wheelhouse	do	do	do	Do.
Chart, lookout, and signal houses.	Measured	do	Measured	Measured.
Boatswain's stores	do	do	do	Do.
Donkey engine and boiler rooms on upper deck.	Measured if connected with engine room; exempted if not so connected.	do	Same as United Kingdom.	Same as United Kingdom.
Hatchways	Exempted up to ½ per cent of gross tonnage; excess is measured.	Same as United Kingdom.	do	Do.
Sail room of sailing vessel	Measured.	Measured.	Measured.	Measured.
Galleys, cook houses, condenser spaces and bakeries.	Exempted	Measured	Exempted	Exempted.
Skylights and domes	do	Exempted	do	Do.

TABLE XII.—*Treatment (in 1913) of superstructures and shelter-deck spaces under the measurement rules of Great Britain, the Suez Canal Co., Germany, and the United States*—Continued.

Portion of vessel.	United Kingdom.	Suez Canal.	Germany.	United States.
Light and air and funnel spaces above engine room.	Owner given option.....	Owner given option under Danube rule, but if measured he forfeits certain exemptions; if German rule is applied they are measured.	Owner given option.....	Owner given option.
Companion houses.....	Measured if used as smoking room; otherwise exempted.	Same as United Kingdom.	Same as United Kingdom.	Same as United Kingdom.
Passageways.....	Measured when serving measured spaces.	.....do.....	.....do.....	Do.
Toilets, lavatories, and bathrooms.	Measured.....	Measured.....	Measured.....	Measured.
Crew and officers' quarters....	.....do.....	.....do.....	.....do.....	Do.
Superstructures above first deck that is not a deck to the hull.	Treated the same as the first tier of superstructures.	Measured if "closed-in" under the national and Suez rules; portions in way of side openings are exempted if "open" under the national rules but "closed-in" under Suez rules.	Same as United Kingdom.	Cabins and staterooms are exempted.
Shelters for deck passengers on short voyages.	Exempted with consent of Board of Trade.	Exempted if "open".....	Exempted with consent of Bureau of Registry.	Exempted with consent of Commissioner of Navigation.
Shelter deck spaces.....	Exempted if "open" according to court decision and Board of Trade instructions. Shelter decks are ordinarily exempted.	Measured if "closed-in" under national and Suez rules; portions in way of side openings are exempted if "open" under the national rules but "closed-in" under Suez rules. The presence of cargo requires measurement forever thereafter.	Same as United Kingdom.	Measured unless "open" according to rules of Commissioner of Navigation. Definition of "open" stricter than in United Kingdom and Germany. Shelter decks are ordinarily measured.
Deck loads.....	Added to net tonnage for tonnage taxation.	Exempted.....	Exempted.....	Exempted.

CHAPTER XII.

INTERNATIONAL UNIFORMITY IN TONNAGE AND MEASUREMENT: PAST EFFORTS, FUTURE POSSIBILITIES.

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In 1862 the British Board of Trade, in a Memorandum Pointing Out the Importanee of the Uniform System of Tonnage Measurement, stated that:

> If one system could be adopted by all maritime nations, so that the capacity of any given ship, when once officially ascertained and denoted on her official papers, could be everywhere understood and recognized as valid, the advantages gained would be very great. The statistics of navigation would be rendered more simple, intelligible, and accurate. The merchant or shipowner would at once understand the size and capacity of the ships he employs or purchases; he would also escape the annoyance and expense of remeasurement; and, lastly, taxation when imposed would be rendered more simple and more just. Under these circumstances there can be but one opinion as to the utility, if not the necessity, of some general system of measuring merchant shipping.[1]

During the half century that has elapsed since this admirable statement was made of the reasons for the international unification of the rules governing the measurement and tonnage of vessels the world's commerce and shipping have increased many fold; the Suez, Amsterdam, Kiel, Corinth, and Manchester ocean ship canals have been brought into existence, and the second of the world's great interoceanic highways—the Panama Canal—has been brought near completion. The importance of international tonnage unity has grown greater with the progress of commercial intercourse among nations, but diversity still prevails in vessel measurement rules.

The opening of the Panama Canal, which will be a commercial event of world-wide influence, suggests, as did the opening of the Suez Canal more than four decades ago, that serious consideration should be given to the necessity of unifying tonnage and vessel-measurement rules. Possibly the completion of the Panama Canal may, as is greatly to be desired, cause efforts to be made to bring about uniform tonnage rules. Should an earnest attempt now be made by Great Britain, the United States, and the other leading commercial nations, the probability of the successful unification of tonnage and measurement rules would doubtless be greater than it was 40 and 50 years ago. The countries of the world are to-day closely united commercially, and their experience in solving problems of mutual interest has lessened the obstacles to international cooperation.

In various parts of this report and of the appendices the differences in the vessel-measurement rules of Great Britain, Germany, France, the United States, and the Suez Canal Co. are pointed out. This indicates what needs to be done to bring about the unification of tonnage practice. A history of the past efforts to accomplish this result will show that the importance of the subject is appreciated by maritime countries and may possibly facilitate the initiation of future negotiations among the leading nations with a view to the early establishment of a single international code of rules for the measuring of vessels and for the determination of the tonnage upon which shipping charges shall be paid in all the ports of the world and at all ocean ship canals. It is for these reasons that this chapter is included in this report upon rules for the measurement of vessels using the Panama Canal.

THE EFFORTS OF THE EUROPEAN COMMISSION OF THE DANUBE TO BRING ABOUT INTERNATIONAL TONNAGE UNIFORMITY.

The treaty of Paris, by which, in 1856, the European Commission of the Danube was established, provided that "all vessels [using the port of Sulina and navigating the lower Danube] should pay alike without distinction of flags." This treaty, like the concession which the Suez

[1] See Report of Select Committee on Tonnage, 1874, p. 231.

Canal Co. received from the Turkish Government and like the Hay-Pauncefote treaty between the United States and Great Britain, requires the charges upon ships to be imposed upon the same tonnage basis and without discrimination. When by 1860 the European Commission of the Danube had carried out the improvements of the Danube sufficiently to warrant the imposition of charges upon shipping making use of the port of Sulina and navigating the lower Danube, a tariff was issued by the commission imposing tolls upon the net tonnage of vessels as determined by the British Merchant Shipping Act of 1854. The size of vessels of different nationalities being expressed in various kinds of tons, the commission worked out a list of factors or percentages to apply to the tonnage of the vessels not measured by the Moorsom system, in order to reduce the tonnage of all ships to the equivalent of their net tonnage, British measurement. In order to secure the information necessary to determine these factors or percentages, the commission applied the British rules to a number of vessels, but the data secured by the commission was obtained by measuring so few ships that the table of equivalents was only roughly accurate. It soon became evident that serious discriminations resulted from the application of the table of percentages, and, as stated by Sir John Stokes, the representative of Great Britain on the commission:

> In the year 1861 the commission formally recorded the desire felt by it that a universal system of tonnage measurement should be adopted in order to establish a real equality between ship and ship and between flag and flag. This desire was repeated from time to time as the protocols of the commission testify.[1]

The efforts of the European Commission of the Danube to bring about uniform tonnage laws in the principal maritime countries of Europe proved unsuccessful and the commission was compelled to adopt its own code of rules. This was done when the new tariff of 1871 was issued. These rules provided for the measurement of vessels by the Moorsom rules, 100 cubic feet being considered a ton, but the rules provided for propelling-power deduction in accordance with the Danube instead of the percentage rule. It was this action of the Commission of the Danube that gave to this rule for propelling-power deduction the name of Danube, although the rule first appeared in the British Merchant Shipping Act of 1854, by which act it was applied to vessels to which the percentage rule did not apply for making propelling-power deductions.

It was not the practice of the European Commission of the Danube actually to measure all vessels to determine their tonnage. The rules of the commission determined what spaces would be included in net tonnage. If the tonnage of such spaces was expressed by the vessel's certificates in other than Moorsom tons of 100 cubic feet, the tonnage was multiplied by such a factor as would reduce it to the equivalent of Moorsom tons—the measurement rules being accompanied by a revised table of equivalents or factors to be applied to the tonnage of vessels of different nationalities. In 1876 the European Commission of the Danube adopted the Suez measurement rules, substituting them for the rules it had adopted in 1871.

NEGOTIATIONS CONCERNING UNIFORM TONNAGE RULES BETWEEN GREAT BRITAIN, FRANCE, AND OTHER COUNTRIES, 1862 TO 1870.

In 1862 Great Britain enacted a law, referred to below, providing that, when any foreign nation adopted the British system of measurement, the tonnage of vessels as stated in their official papers would be accepted at the British ports without remeasurement of the ships concerned; and, at the time of the enactment of this law, the British Board of Trade, through the foreign office, submitted to the French Government the memorandum quoted at the beginning of this chapter, "pointing out the importance of the uniform system of tonnage measurement." This memorandum urged other countries to adopt the leading features of the British Merchant Shipping Act of 1854.

This appeal on the part of the British Government caused the French Government to appoint, in 1863, a commission to investigate and report upon tonnage. This was, in fact, the third commission which France had appointed within a comparatively short time. There had been a commission established in 1855, and another in 1861, to report upon the advisability of changing the French measurement rules as adopted in 1837.

[1] Report of the Select Committee of the House of Commons on Tonnage, 1874, p. 3.

The commissions of 1855 and 1861 did not recommend the adoption by France of the Moorsom system, but the commission of 1863 recommended that France adopt and put in force the Moorsom system and the British measurement rules. Unfortunately, no action followed this recommendation, although the subject was not abandoned by the French Government, as is evidenced by the statement by the French minister of foreign affairs, made in 1869 in a letter addressed to De Lesseps, president of the Suez Canal Co. A commission that De Lesseps had appointed in 1868 to recommend a tonnage basis for the Suez Canal tolls had advised the company to levy the Suez tolls upon the net tonnage of vessels as stated in their certificates of registry until the negotiations then in progress for the international unification of tonnage had been successful. The statement made by the French minister of foreign affairs was that:

> My department is especially occupied with this important question of agreement with other competent administrations, and, at the suggestion of the European Commission of the Danube, has put itself to work with the British Government to elaborate in common an international system of measurement to be submitted for acceptance by all the States. These labors have not yet had any definite result, but they are in search of one, and the opening of the Suez Canal will have the effect of hastening a solution which is of interest to the entire commercial world, while showing the impossibility of maintaining the present conditions longer.[1]

While these negotiations between France and Great Britain were being carried on, communications of similar tenor were being exchanged by other maritime countries. The only countries, however, that took action were the United States, 1865, and Denmark, 1867, which adopted the Moorsom system of measuring vessels and the Moorsom ton as the unit of vessel size.

Whatever might otherwise have been the result of these negotiations, they were temporarily brought to naught by the outbreak of the Franco-Prussian War in 1870. Another reason why international negotiations carried on between 1862 and 1870 failed to bring about uniform measurement and tonnage rules was the decision of the British courts in 1866 holding that the Board of Trade had acted without the authority of law when, in 1860, it abandoned the percentage rule concerning propelling-power deductions.

The Board of Trade in its memorandum of 1862, which was made the basis of international negotiations concerning the unification of tonnage, had stated that "in 1854 an attempt was made to determine this deduction (for propelling power) by a fixed percentage, but the difficulties of doing this fairly and universally have proved so great that it has been found necessary to adopt the plan of simply measuring the contents of the space and to deduct them from the aggregate contents of the ship." This administrative order concerning propelling-power deductions made in 1860 having been held to be illegal by the High Court of Justice, in 1866, the Board of Trade and the British Government were thereby embarrassed in urging other nations to adopt the British tonnage rules, as embodied in the act of 1854. The Board of Trade besought Parliament to amend the act of 1854, but without success.

ADOPTION OF MOORSOM TONNAGE SYSTEM, AND ACCEPTANCE OF TONNAGE CERTIFICATES.

The United States and Denmark were the only countries that adopted the Moorsom ton and the Moorsom system of vessel measurement prior to 1871; but, between 1870 and 1880, all of the maritime nations of Europe, with the exception of Belgium, adopted the Moorsom tonnage and measurement system. The following table states the date upon which the Moorsom system became effective in the countries of the world that have thus far taken action:

TABLE XIII.—*Nations that have adopted the Moorsom ton and the Moorsom measurement system.*

Nation.	Date on which effective.	Nation.	Date on which effective.
United Kingdom	May 1, 1855	Spain	Dec. 2, 1874
United States	Jan. 1, 1865	Netherlands	Jan. 1, 1876
Denmark	Oct. 1, 1867	Norway	Apr. 1, 1876
Austria-Hungary	Sept. 1, 1871	Argentina	Jan. 1, 1877
Germany	Jan. 1, 1873	Finland	June 1, 1877
France	June 1, 1873	Greece	July 1, 1878
Italy	July 1, 1873	Russia	Dec. 20, 1879
Chile	Jan. 1, 1875	Haiti	Jan. 26, 1882
Sweden	Apr. 1, 1875	Belgium	Jan. 1, 1884
Turkey	——, 1875	Japan	July 1, 1885

[1] Letter of Oct. 6, 1869, to president of the Suez Canal Co.

The action taken by most of the maritime nations of the world in adopting the Moorsom ton of 100 cubic feet and the Moorsom system of measuring vessel spaces was but the first step toward international unification of tonnage rules and practice. In order to bring about international tonnage unity, it is necessary that the measurement rules of all countries should be uniform, i. e., that all rules should include in gross tonnage the same spaces and that all rules should make the same deductions from gross tonnage to determine net tonnage. The general adoption of the Moorsom tonnage system made possible, but was not followed by, the international unification of tonnage and vessel measurement.

The adoption by the principal maritime countries of the world of the Moorsom ton and the Moorsom method of measuring vessel spaces favored the acceptance by each of the principal countries, as the basis of port charges and tonnage taxes, of the tonnage certificates issued by countries that had adopted the Moorsom tonnage rules. This action was anticipated by the British Government which provided in a statute enacted in 1862 that:

> Whenever it appears to Her Majesty the Queen in council that the tonnage regulations of this act have been adopted by any foreign country, and are in force there, Her Majesty in council may order that the ships of that country shall, without being remeasured in Her Majesty's dominions, be deemed to be of the tonnage denoted in their certificates of registry or other national papers in the same manner, to the same extent, and for the same purposes as the tonnage in the certificate of registry of a British ship is deemed to be the tonnage of that ship.

A provision similar to this was enacted in the United States tonnage law of 1864—the law which adopted the Moorsom system for measuring vessels. The present phraseology of the American statute of 1864 is that:

> Whenever it is made to appear to the Secretary of Commerce [and Labor] that the rules concerning the measurement for tonnage of vessels of the United States have been substantially adopted by the Government of any foreign country he may direct that the vessels of such foreign country be deemed to be of the tonnage denoted in their certificates of register and other national papers, and thereupon it shall not be necessary for such vessels to be remeasured at any port in the United States.

Following the enactment of the law of 1862, Great Britain began to enter into reciprocal tonnage agreements with other nations providing for the acceptance, by the countries entering into such arrangements, of the tonnage certificates of the vessels under their respective flags. Agreements were made with the United States and Denmark in 1868 and with Austria-Hungary in 1871. These agreements were without restrictions; but those subsequently entered into by Great Britain and other countries generally stipulated that foreign certificates would be accepted only in so far as the measurement rules of the countries entering into agreements were alike, and that the tonnage as stated in certificates would be increased or decreased by admeasurers so as to make the tonnage upon which light dues or other shipping charges were levied the equivalent of the tonnage which the vessel would have if measured by the rules of the countries imposing the charges. This was necessary because of the insistence by Great Britain upon adhering to the 32 per cent rule in making propelling-power deductions and upon considering as open the spaces under so-called shelter decks provided with "tonnage openings." These provisions of the British measurement rules made the net tonnage of British vessels less than the net tonnage of vessels of the same size when measured by the rules of most other countries.

Prior to 1895 the United States, Germany, and some other maritime countries made propelling-power deductions, either in accordance with the Danube rule or by the actual measurement of deducted spaces, and it was customary for Great Britain to permit the remeasurement of vessels at her ports and to give them the advantage of the larger deduction from net tonnage provided for by the British rule as to propelling-power allowances. To facilitate the correction of net-tonnage figures at foreign ports, some countries, including Germany, Sweden, Norway, Denmark, and the United States, have provided that their official admeasurers shall provide the masters of vessels not only with the certificate of the vessel's official tonnage, but also with statements showing what spaces in the vessel are entitled to deduction from gross tonnage by the rules of foreign countries. This may be illustrated by quoting the provision of the statute of the United States now in force, which is as follows:

> Upon application by the owner or master of an American vessel in foreign trade, collectors of customs, under regulations to be approved by the Secretary of Commerce, are authorized to attach to the register of such vessel an

appendix stating separately, for use in foreign ports, the measurement of such space or spaces as are permitted to be deducted from gross tonnage by the rules of other nations and are not permitted by the laws of the United States.

The United States has reciprocal arrangements of the kind above indicated with Great Britain, Belgium, Denmark, Austria-Hungary, Germany, Italy, Sweden, Norway, Spain, the Netherlands, Russia, Finland, Portugal, and Japan. The American measurement rules produce a net tonnage larger than results from the application of the rules of most of these countries, and American admeasurers thus add to the tonnage of foreign ships the spaces which our rules include in tonnage and which the rules of foreign nations omit therefrom.

The official instructions under which American admeasurers act are that "the like courtesy having been extended to vessels of the United States, it is directed that vessels of those countries whose registers indicate their gross and net tonnage under their present law shall be taken in ports of the United States to be of the tonnage so expressed in their documents, with the addition of the amount of the deductions and omissions made under such law not authorized by the admeasurement law of the United States."

Inasmuch as the British measurement rules give vessels a lower net tonnage than do the rules of most other countries, Great Britain is willing to accept, for purposes of taxes upon shipping, the tonnage without alteration as stated in the certificates of the vessels of foreign countries. The arrangement between Great Britain and Greece is that Greek steamers may be remeasured in the United Kingdom for engine room deduction—the Greek rules providing for smaller deductions by applying the Danube rule. The arrangement between Great Britain and Sweden provides for the acceptance by Great Britain of British tonnage when separately stated in the certificates issued to Swedish vessels by the admeasurers of Sweden.

The general practice now prevailing among commercial nations of accepting the tonnage certificates of vessels of foreign registry is of advantage to commerce and shipping, because it minimizes the expense and delays that would result from the measurement of vessels when subjected to tonnage charges at foreign ports. This practice, however, merely lessens the disadvantages resulting from dissimilarity in the tonnage rules of different countries. The arrangements providing for the acceptance at the ports of each country of the tonnage certificates of foreign vessels in accordance with special international regulations, have been made necessary by the lack of international unity in tonnage and vessel measurement. These agreements would be unnecessary and international commerce could be carried on more advantageously if the commercial nations of the world could agree upon common tonnage rules.

THE INTERNATIONAL TONNAGE COMMISSION OF 1873.

The opening of the Suez Canal in 1869 led to the convening of an international tonnage commission which met in Constantinople the latter part of 1873, and which provided a set of vessel-measurement rules that the members of the commission thought would be adopted by the countries represented at Constantinople and would lead to the international unification of tonnage and vessel measurement. As has been explained, this expectation was not realized, because of the refusal of Great Britain the following year to substitute the rules framed at Constantinople for those embodied in the British Merchant Shipping Act of 1854. Had Great Britain adopted the Constantinople rules, it is certain that other countries would have done so.

As has been set forth in Chapter IX, the occasion of the convening of the International Tonnage Commission at Constantinople was the necessity of defining the phrase "ton of capacity" as used in the act of concession granted to the Suez Canal Co. by the Ottoman Government in 1856. Section 17 of that concession provided that the dues imposed by the canal company should "be collected without exception or favor from all ships, under like conditions," and "that for the special navigation due the maximum toll shall not exceed 10 francs per ton of capacity on vessels and per head of passengers."

In 1868, De Lesseps, the president of the Suez Canal Co., appointed a commission to consider problems connected with the operation of the canal and among the questions referred to this commission was that of determining the type or kind of tonnage upon which the charges imposed by the company for the use of the canal should be levied. While the commission

was deliberating upon this question active negotiations, with a view to the international unification of vessel tonnage and measurement rules, were in progress with prospects of early success. Accordingly, the commission appointed by De Lesseps recommended that "while awaiting the adoption of a universal rule [of measurement] the company levy dues according to the tonnage stated in the ship's papers without regard to the flag." The regulations adopted by the company under date of August 17, 1869, stipulated that "tonnage [upon which tolls are paid] will for the present (jusqu'à nouvel ordre) be that stated in the official papers carried by vessels."

This provided for the payment of tolls upon net or register tonnage, and it was soon discovered that the net tonnage was often 40 to 50 per cent less than the gross tonnage. The revenues of the canal company being insufficient during the early years of the operations of the waterway to enable the company to meet its capital charges, the company felt obliged to increase its revenue. One of the steps taken was to substitute gross for net tonnage as the basis on which charges should be imposed. This change was made July 1, 1872, upon the recommendation of a commission that had been appointed by the company the previous year. As was explained in Chapter IX, this action of the Suez Canal Co. was vigorously opposed by the shipping interests, their opposition being supported by several of the European powers. Pressure having been brought by the European powers upon the Turkish Government to settle the question, the Porte invited the European Governments to send delegates to an international commission to meet in Constantinople or London.

In requesting the European nations to send delegates to an international commission, the Ottoman Government stated it to be "the desire of the imperial Government to insure an equal treatment of all ships without distinction of flag that use the ports of the Empire" and "expressed the opinion that the adoption of a uniform tonnage will be regarded with favor by maritime countries." It was further stated by the Ottoman Government that it "did not doubt that a commission of experts and men of practical experience would be able to find a uniform method of measuring ships and of fixing upon a standard ton that may serve at the same time as the basis for commercial transactions and for the collection of charges to which vessels are subject."

The delegates sent to Constantinople by the maritime powers of Europe were not authorized to bind their respective Governments to a change in national measurement rules. The foreign office of the British Government, for instance, was careful to state "that the conclusions at which the commission may arrive shall not become operative until they have been referred to all the powers, and shall have been accepted by them."[1] In this same communication, however, it is stated that "Her Majesty's Government have constantly urged the importance of a uniform standard of tonnage measurement * * * They are therefore glad to join in such a commission." Thus while the British Government participated in the deliberations of the Constantinople commission primarily for the purpose of assisting in deciding what should be the basis of charges at the Suez Canal, Great Britain was also willing that her delegates should join with those from other countries in efforts to work out a system of measurement rules that would be acceptable to commercial countries generally.

The German Government was careful to instruct its delegates to the Constantinople convention to give primary consideration to the settlement of the Suez Canal tonnage question. Germany had recently, by the act of 1872, adopted the Moorsom system of measuring vessel spaces, and had thus established uniform measurement rules to apply in all the States of the Empire, and the German Government accordingly felt that it would not be desirable to change the tonnage rules it had recently adopted. This is shown by Prince Bismarck's instructions to the German ambassador at Constantinople. In a letter dated March 18, 1873, the chancellor stated:

> By the ship measurement ordinance issued on the 5th July, 1872, the process of admeasurement for sea ships is made uniform throughout Germany, and is regulated on the method originally English, now introduced in almost all European States. We are, therefore, no longer in a position to treat this question as an open one, of which the solution for Germany should depend upon an international commission. Germany would not be able to take part in a negotiation which treated of altering the aforesaid British-German system. On the other hand, supposing the maintenance of that system not to be called in question; we also might take part in a discussion as to what deductions are to be

[1] Earl Granville to Sir H. Elliott, Mar. 3, 1873.

made from the gross capacity; that is, the capacity of all the internal parts of a ship and the fixed erections thereon (gross tonnage), in order to settle the net capacity which is to regulate the levy of dues.

The International Tonnage Commission in the course of its deliberations soon found that the delegates present were primarily interested in the formulation of a set of tonnage rules to be adopted by the nations of the world and only secondarily interested in deciding upon rules to determine the tonnage upon which the Suez Canal charges should be paid; and the rules which the commission drafted for application at Suez were framed with a view to subsequent adoption by the several countries represented at Constantinople. The interest which the Constantinople commission had in formulating an international code of measurement rules is indicated by a report made by the two British delegates to their Government soon after the adjournment of the commission.

> Our instructions at first prescribed that the general question of tonnage should, if possible, be reserved for examination in London, and that the questions relating to the Suez Canal dues should form the principal subject of inquiry. We had very early to point out that this order of inquiry was hardly possible, on account of the conflicting instructions of the different delegates, and that it did not promise to be attended with success. The whole tenor of the Turkish instructions, and those of some of our colleagues, indicated the tonnage question as the principal one that was to occupy the attention of the commission.[1]

The leading member of the Constantinople commission was Sir John Stokes, one of the two English delegates. The statement which he made in 1874, when testifying before the select committee of the House of Commons regarding the work of the International Tonnage Commission, shows clearly that the commission's first interest was in the international unification of tonnage practice. His statement was:

> An international commission was last year assembled at Constantinople which, taking the English law of 1854 for a basis, has drawn up a set of recommendations which remedied the defects of that law. The international commission had no power to bind the governments represented in it, but it conscientiously endeavored to solve the problems of tonnage measurement, and more especially those of the additions to be made for covered-in spaces to determine the gross tonnage, and of the deductions which should be made from the latter in order to determine the net or official tonnage of each ship.

An account of the efforts of the British Board of Trade to secure action by Parliament to amend the Merchant Shipping Act of 1854 so as to incorporate in that law the tonnage rules adopted at Constantinople is given in Chapter IX. The efforts of the Board of Trade in 1874 and in 1881 to secure the amendment of the act of 1854 having failed through the opposition of the shipowners to an increase in the net tonnage upon which shipping charges were payable, the internationalization of tonnage rules by the general adoption of the rules formulated at Constantinople was prevented.

Great Britain having refused to amend her Merchant Shipping Act of 1854, other commercial nations felt obliged, on account of the leading position of British shipping, to adapt their tonnage laws to those to which Great Britain insisted upon adhering. Italy adopted the percentage rule for propelling-power deductions in 1882, Japan in 1884, Norway in 1893, Denmark, Germany, and the United States in 1895, Holland in 1899, Russia in 1900, and Spain in 1902. From 1873 until 1904 France permitted vessel owners the option of having propelling-power deductions made by the British Board of Trade rule, with a 40 per cent maximum deduction, or by the German rule; but in 1904 France adopted the Board of Trade rule.

Likewise, as regards the exemption of superstructures from measurement, many commercial nations felt obliged to follow the lead of Great Britain. Germany provided in 1895 for the treatment of superstructures and shelter-deck spaces in accordance with the rules prevailing in Great Britain. Sweden and Russia have taken similar action. The United States, however, has thus far wisely declined to adopt the British interpretation of the words "open" and "closed-in" as applied to superstructures and to spaces under the so-called shelter deck. However, the tendency during recent years has been to increase exemptions and deductions of the above-deck spaces. The practice of the several countries is not uniform and the net tendency is away from rather than toward uniformity.

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[1] Despatch from Col. Stokes and Sir P. Francis to Earl Granville, Dec. 31, 1873.

PAN AMERICAN CONFERENCE, 1890.

At the Pan American Conference, which met in Washington in 1890, there was a lengthy discussion of tonnage and of charges on shipping.[1] Consideration was given to these questions, because it was thought that shipping was hampered by an unnecessary number and variety of tonnage taxes and harbor dues, and because it was realized that the practice of levying shipping charges on net tonnage resulted in lower taxes and dues for the vessels of some countries, notably Great Britain, than for vessels of other countries. To lessen and equalize the burdens on shipping and to bring about greater uniformity as regards tonnage practice, it was resolved by the conference to recommend to the several American Governments:

> First, That all port dues be merged in a single one, to be known as tonnage dues.
>
> Second, That this one charge shall be assessed upon the gross tonnage, or, in other words, upon the total carrying capacity of the vessel.[2]

It is evident that the delegates to the conference had incomplete knowledge of tonnage questions. The resolutions indicate a confusion of gross tonnage—which is closed-in capacity—with total carrying capacity. It is also manifest that the delegates who brought about the adoption of the above resolutions did not appreciate the diversity in the gross-tonnage rules of different countries, nor did they give due weight to the serious discriminations, as among vessels of different types, that would result from levying shipping charges on gross tonnage.

The maritime powers of Europe not being members of the Pan American Conference, the only country having large commercial and shipping interests represented at the conference was the United States, and the action taken by the conference attracted little attention. The United States Commissioner of Navigation in his annual report for 1890—made after the meeting of the conference—recommended that Congress substitute gross for net tonnage as the basis of tonnage taxes; but, fortunately, no action was taken by Congress.

ACTION TAKEN BY THE INTERNATIONAL INSTITUTE OF STATISTICS, 1889–1891.

It is realized by all who have had occasion to make commercial investigations and thus to compile statistics of vessel tonnage that these statistics are subject to two serious limitations. Vessels of the same size do not have the same tonnage in different countries, and the rules governing the recording of vessel movements—the statistics of the entrances and clearances of vessels at the ports of different countries—are so variant as to vitiate the statistics of international vessel movements. Special care must be taken in compiling statistics of the tonnage of shipping employed in international trade, and even then the figures can be only approximately accurate for the trade between some countries.

The importance to science of having uniform rules in all countries for determining vessel tonnage impressed itself upon the International Institute of Statistics, which, at the meeting held in Paris in 1889, appointed a committee to investigate and report upon tonnage and vessel measurement. The seven members of the committee consisted of men from Norway, Great Britain, Germany, France, the United States, Russia, and Italy. At the meeting of the institute two years later in Vienna the committee recommended that the International Institute of Statistics "call the attention of the interested Governments to the grave inconvenience resulting from the condition of tonnage measurement and recommend to them the advisability of submitting their rules for investigation to an international commission of technical experts." The recommendation of the committee was adopted by the institute and transmitted to the commercial powers; but, like other wise resolutions that have been adopted by scientific associations, no practical results followed.

Accurate statistics of international vessel movement will be impossible as long as there is a lack of uniformity in the rules governing the recording of the entrance and clearance statistics at the ports of different countries. The present diversity in the methods or rules governing the records of vessel movements in different countries is indicated by the following statement taken from the report upon Panama Canal Traffic and Tolls:

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[1] 51st Cong., 1st sess. (1890), S. Ex. Doc. 232, pt. 1, pp. 412–502.

[2] Ibid., p. 502.

The methods or rules followed in recording entrances and clearances in the various nations are not uniform. The regulations of the United Kingdom provide that vessels bringing cargo from more than one foreign port are to be recorded as entering from the first port at which cargo for the United Kingdom was embarked; and that loaded vessels departing from the United Kingdom for more than one foreign port are listed as clearing for the last port to which their cargo is consigned. Vessels in ballast are recorded as entering from the last foreign port at which they touched before reaching the United Kingdom, and as clearing to the first foreign port to which they are bound. The rules of France, Belgium, Germany, and Austria are essentially the same as the British. The Italian regulations, however, provide that when vessels with cargoes come from or go to more than one foreign country, each country is credited with the tonnage.

The rules in force in the United States state that "in tabulating clearances to foreign ports, the tonnage is credited to the country in which is located the first foreign port at which the vessel will enter for discharge of cargo; but if the bulk of the cargo is to be discharged at some other foreign port, the tonnage will be credited to the country in which that port is located. In cases of entrances, the first foreign port from which the vessel sailed with cargo for the United States is that to which the entered tonnage will be credited." The American rule for entrances is therefore like the rules of Great Britain, Germany, Belgium, France, and Austria, but the American rule for clearances is different.[1]

THE PRESENT DIVERSITY ON NATIONAL TONNAGE MEASUREMENT RULES.

The rejection, in 1881, by the British Parliament of the Board of Trade's proposition of substituting the Constantinople-Suez tonnage rules for those of the Merchant Shipping Act of 1854 seems to have convinced the commercial nations that the unification of tonnage rules on the basis of those adopted at Constantinople was for the time being impossible. The subject was discussed by the interested officials of the several countries, and, as has been pointed out, several countries, in order to put their shipping on an equal footing with that of Great Britain as regards tonnage taxes and port charges, adopted the British rule for propelling-power deductions.

In his report for 1894 the United States Commissioner of Navigation states that "a proposition for an international conference to devise an international scheme of uniform measurement has been submitted by the Belgian Government, but the project has not been considered practical." Presumably, the proposition of the Belgian Government was submitted to all interested countries, but it is evident that the responses received by the Belgian Government were not encouraging, for nothing came of the proposal.

Although several countries have adopted the 32 per cent rule for propelling-power deductions, and although some countries have adopted the British definition of "open" and "closed-in" spaces in superstructures, there are, as has been shown in detail in Chapters IV, V, IX, and XI, and in Appendix VIII of this report, wide variations in the present national measurement rules. The rules differ in many details, some of which have a large influence upon tonnage.

The British and German rules correspond more closely than do the rules of other countries. They are, indeed, substantially the same, as interpreted by the admeasurers in the two countries; but the British and German rules and practices differ from those prevailing in the United States and at the Suez Canal (1) in the treatment of superstructures and of the large spaces under the so-called shelter deck, and (2) in the deductions for engine room and bunker spaces—the American rules being somewhat unlike those of Great Britain and Germany, while the Suez Canal rules are radically different.

The national rules of the United States, Great Britain, and Germany differ from the Suez rules in the treatment of (1) crew spaces, (2) accommodations for the master, clerk, purser, and doctor, (3) water-ballast spaces, (4) boatswain's storerooms, (5) the sail room on sailing vessels, and (6) light and air and funnel spaces above the engine and boiler room.

The effects which these differences have upon gross and net tonnage are illustrated by Table V, Chapter V, page 83. This table gives the gross and net tonnage of eight vessels as measured by the British, American, and Suez rules. The aggregate net tonnage of these vessels, as measured by the British rules, is 36.2 per cent less than the aggregate gross tonnage. As measured by the American rules, the net tonnage is 33.3 per cent less than the gross; and, as measured by the Suez rules, the net tonnage is only 24.2 per cent less than the gross. The

[1] Report upon Panama Canal Traffic and Tolls, by E. R. Johnson, Special Commissioner on Panama Canal Traffic and Tolls, pp. 21–22, Washington, 1912.

influence of national rules upon vessel tonnage is also illustrated by Table VII, Chapter V, page 85, which table gives the aggregate gross and net tonnage of the metal steam vessels of the merchant marines of all the maritime countries of the world.

The percentage deducted from gross tonnage in the determination of net tonnage ranges from 32 to 42 per cent, not counting the unimportant marines of Peru and Roumania, in which the net tonnage is 48 and 47 per cent, respectively, less than the gross tonnage. It is interesting to note that for the comparatively large merchant marine of Holland, 32 per cent is deducted from gross tonnage to determine net tonnage; whereas France, close to Holland on the south, makes net tonnage 42 per cent less than gross, and Denmark, not far from Holland on the north, makes net tonnage 41 per cent less than the gross. Holland's neighbor on the east, Germany, and her neighbor across the English Channel, Great Britain, make the tonnage 39 per cent less than the gross. It will be understood that these comparisons of gross and net tonnage express the relationship between two variables, and thus do not fully indicate the differences in the measurement rules of the several countries. The variation as among countries is both in the rules concerning gross tonnage and in the rules determining net tonnage.

A BASIS FOR INTERNATIONAL TONNAGE UNIFORMITY.

The first two steps toward the attainment of international uniformity of tonnage rules and practice were taken when the maritime nations of the world severally adopted the Moorsom system of measuring vessel spaces and when international arrangements and agreements were entered into providing for the acceptance, for the purpose of levying shipping charges at the ports of each country, of the tonnage stated in the certificates of vessels of foreign registry. In some cases these international arrangements provide for such alterations in the registered tonnage of foreign ships as may be necessary to make the tonnage correspond to the tonnage that the vessels would have if measured by the rules prevailing in the country imposing the port charges upon shipping; but vessels entering ports are seldom measured, as a whole, by the officials imposing light dues or other port charges.

The failure to take the third step necessary to the attainment of international uniformity in tonnage practice—the unification of measurement rules—is due to the refusal of Great Britain in 1874 and in 1881 to adopt the measurement rules formulated by the International Tonnage Commission which met at Constantinople in 1873. Great Britain has insisted upon adhering to the policy of making gross tonnage less than the closed-in capacity of vessels and net tonnage less than the space or capacity available for passengers and cargo, because, her subjects having the dominant position in the shipping world, the British Government desired to give the vessels of its subjects an advantage over the owners of shipping under the flags of other countries as regards charges payable at the ports of the world. Great Britain's insistance upon this policy has caused other nations to follow her lead in reducing gross and net tonnage, but the result has not been international uniformity.

Indeed, international uniformity in vessel measurement rules can be brought about and maintained only by the adoption by the commercial countries of rules based upon sound principles. Rules intended to make net tonnage much less than the earning capacity of vessels will not find favor with all countries, nor will such rules be acceptable to the owners of the Suez, the Panama, and other ocean-ship canals for the use of which vessels are necessarily charged tolls.

Sir W. H. White, of Great Britain, a marine architect of high standing, has stated that "international tonnage has many obvious advantages, and if ever a universal law is arranged by maritime nations, it will probably be based on the Suez Canal regulations." [1] This observation is undoubtedly sound in the sense that uniform rules for all countries must be based upon the principles that underlie the Suez Canal regulations and which are made the basis of the Panama measurement rules. It is certain that when an international measurement code is formulated, it will make gross tonnage the equivalent of the closed-in capacity of vessels, and make net tonnage closely approximate the usable capacity of vessels.

The Suez rules were framed by an international commission that expected its rules to be adopted by the commercial countries of the world. The commission which labored at Con-

[1] Naval Architecture, p. 56.

stantinople sought to lay the foundation for the unification of measurement rules and practices. The rules framed at Constantinople were within a short time adopted by the European Commission of the Danube. The British Board of Trade, in 1874, and the Board of Trade and the most able Royal Commission on Tonnage, in 1881, strongly urged Parliament to adopt the Constantinople rules. The effort of the Board of Trade and the Royal Commission on Tonnage failed not because of any objection urged against the Suez rules, but because of the opposition of shipowners to an increase in net tonnage. The Panama rules have been framed with a view to carrying out the principles that were adhered to by the International Tonnage Commission at Constantinople in 1873. The Suez and Panama rules differ in minor details, but could readily be brought into harmony with each other. They constitute the natural basis upon which to build an international code of measurement rules.

A large share, probably the major portion, of the vessels engaged in over-sea international trade will use the Suez Canal or the Panama Canal, or both of them. It would accordingly seem that the opening of the Panama Canal might lead to the early remodeling of the several national measurement rules with a view to bringing them into harmony with the Suez and Panama rules—the two measurement codes that are based upon sound principles.

Doubtless the most effective method of inaugurating a movement for the international unification of tonnage rules would be for Great Britain, or for Great Britain and the United States jointly, to call a conference to formulate a code of vessel measurement rules to be recommended by the conference for adoption by the commercial nations of the world. The recommendations of an international conference would carry much more weight, and would have more prospect of adoption, than would the proposal of any one Government.

CHAPTER XIII.

COMPARISON OF THE PANAMA AND SUEZ MEASUREMENT RULES.

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COMPARISON OF THE PANAMA AND SUEZ MEASUREMENT RULES.

INTRODUCTION.

The Panama and Suez measurement rules are based upon the same general principles. Both sets of rules seek to include in gross tonnage the entire closed-in capacity of vessels and to make net tonnage the approximate equivalent of the earning capacity of vessels.

The two sets of rules, moreover, correspond closely in their main provisions, although they differ in detail. The variations in the two measurement codes are due chiefly to the fact that the Panama rules were drafted 40 years after the Suez rules were formulated. During that time the progress in ship building has brought about great changes in the designs of ships, and entirely new types of vessels have come into existence. There has been a differentiation and specialization in the types of carriers used for the performance of ocean transportation. Moreover, the navigation laws and regulations affecting crew spaces and other maritime matters have been amended from time to time.

The Panama rules, naturally, have been framed with present-day ship-building and navigation practices in mind. It is probable that if the Suez rules were being drafted anew to-day they would vary in numerous details from the provisions of the rules that were adopted by the International Tonnage Commission which met at Constantinople in 1873. To some extent the Suez rules have been modified and supplemented to keep them abreast of ship designs and maritime practice, but, as the rules were formulated by an international commission, the Suez Canal Co. has no authority to modify the rules and has not been able to secure many changes in the rules as they were drafted in 1873.

As has been pointed out in this report, the several national rules have important variations and they differ widely from the Suez rules. The provisions of the British, German, American, and Suez rules have been compared in detail in the text of this report, and in Appendix VIII of the report there is a comparative analysis of the French, British, and German rules. The report, moreover, states fully the reasons why it was thought wise to base the Panama rules upon the principles that underlie those of the Suez Canal Co. and to make the main provisions of the two measurement codes as nearly alike as was warranted by the changes that have been made during recent decades in ship designs, navigation laws, and maritime practice.

The Suez rules being well understood by vessel owners and ship builders and by the measurement officials of all commercial countries, it will doubtless contribute to a more ready understanding of the Panama rules to point out briefly the similarities of and differences in the provisions of the two measurement codes. This comparison may also assist those who may in the future consider the possibility of amalgamating the two codes of rules with a view to laying the foundation of the international unification of tonnage and vessel measurement.

SIMILARITIES OF THE PANAMA AND SUEZ RULES.

The similarity of the Panama and Suez rules will be made evident by a brief reference to the provisions which necessarily constitute the main elements not only of those two sets of rules but of all vessel measurement codes, the provisions as to the system of measuring spaces and as to the unit adopted for expressing the tonnage, the provisions regarding gross and net tonnage, the definition of closed-in spaces, and the deduction made for propelling machinery and fuel.

Vessel spaces are measured in practically all countries by the Moorsom system, and the tonnage of vessels is everywhere expressed in Moorsom tons of 100 cubic feet. The Panama, the Suez, and all the national rules are practically the same as regards the system of measuring vessels and as to the unit employed in the expression of tonnage. The Panama rules provide that vessel spaces may be measured either by the Moorsom system as contained in the rules themselves or by the Moorsom system followed by the officials who measure vessels in different countries for national registry, provided the rules of the foreign country whose officials are making the measurement are substantially the same as the Moorsom system of measurement as set forth in the Panama measurement rules. It is expected that the tonnage of vessel spaces measured by the officials of foreign countries for the national registry of vessels will be practically the same as the tonnage would be if the spaces were measured by the system of measurement set forth in the Panama rules.

The Suez Canal Co.'s rules embody the Moorsom system of measurement, but do not specifically provide for accepting the tonnage of spaces when measured by the Moorsom system as contained in the national measurement codes. It is, however, the practice of the Suez Canal Co. to accept as correct the tonnage of spaces as stated in the certificates of national registry. In other words, the Suez Canal Co. does not require the admeasurers of Great Britain, Germany, and other countries actually to measure all parts of a vessel before issuing a Suez tonnage certificate, provided the vessel has previously been measured in accordance with the national registry rules. The requirement of the Panama and Suez rules as to the measurement of spaces included in gross tonnage will thus be essentially the same in practice.

It being the aim of both the Suez and Panama rules to include in gross tonnage the entire closed-in capacity of vessels, the sole criterion to be applied in deciding whether particular spaces, other than double-bottom compartments, shall be measured in, or exempted from, gross tonnage, is whether the spaces are, or are not, closed-in. No spaces, other than those in the double-bottom, are to be exempted from measurement because of the use to which they are put. Strict adherence to this principle gives a definite meaning to gross tonnage as determined by each of the two sets of rules.

The provisions of the Panama and Suez rules concerning deductions from gross tonnage to determine net tonnage are intended to make net tonnage the closest practicable equivalent of actual earning capacity. Vessels being of many types, the spaces required for crew, navigation, and power purposes vary greatly and the spaces deducted are much larger for some vessels than for others. It is, accordingly, hardly to be expected that the deductions provided for by the Panama rules drafted in 1913 will be exactly identical with the deductions provided for in the rules framed in 1873 (although the rules of 1873 have been subsequently modified to some extent); but the general adherence, in the provisions of both sets of rules, to the principle that deductions shall be limited to spaces not available for the accommodation of passengers or the stowage of cargo, results in nearly the same deduction in both the Panama and Suez rules. The differences in the deductions actually made by the rules will be pointed out in a later connection.

Both the Panama and Suez rules so define "permanently covered and closed-in spaces" as to include therein all spaces that are so inclosed as to make them available for the accommodation of dry cargo, stores, crew, or passengers. Both sets of rules provide that spaces under a deck with an opening that can be closed-in after the ship has been measured so that the space under the deck will be thereby better fitted for the transport of goods or passengers shall be considered as closed in. Thus a "tonnage opening" that can be closed when the vessel is at sea, but which, under the British and German rules, would entitle the space between the deck with the "tonnage opening" and the deck next below to exemption is not recognized by the Panama and Suez rules as an opening which makes the between-deck space "open." The Panama and Suez rules seek by careful definition to prevent spaces usable for cargo or passengers in superstructures or under a deck with a "tonnage opening" from being exempted from gross and net tonnage. The two sets of rules further agree in stipulating that the use of

any exempted space for passenger accommodations or for carrying stores, fuel, or cargo requiring protection from the sea shall cause the exempted space to be permanently added to gross and net tonnage.

Both the Panama and Suez measurement codes provide that the Danube rule shall be followed in deducting the spaces occupied by propelling machinery and fuel on vessels without fixed bunkers or fuel spaces, and both rules give the owners of vessels with fixed bunkers or fuel spaces the option of having propelling-power deductions made by the Danube rule or by the actual measurement of the spaces occupied by propelling machinery and fuel. The Danube rule gives a fair average deduction for propelling power spaces and would doubtless be the rule followed at the present time in most countries of the world had not the efforts of the British Board of Trade to secure its adoption in Great Britain, in 1874, and, in 1881, been prevented by ship owners opposed to having the net tonnage of their vessels made equal to the real earning capacity of their ships.

The Danube rule as embodied in the Panama measurement code is slightly different from its statement in the Suez regulations. The Panama rules include in the engine room light and air spaces and spaces framed in around the funnels up to the covering of the first tier of side-to-side erections on the uppermost full-length closed-in deck. All light and air and funnel spaces above that are always exempted from measurement by the Panama rules. Since 1904 the Suez rules have permitted the exemption of light and air and funnel spaces above the uppermost full-length closed-in deck, and in addition they have permitted the exemption, in the first tier of superstructures, of the entire spaces on both sides of the light and air casings and smoke funnels. Since 1904 the Suez rules have permitted the inclusion within the engine room of light and air and funnel spaces above the uppermost full-length closed-in deck, provided the owner of the vessel elects to have the light and air and funnel spaces above that deck included in the engine room, and provided, further, that the owner of the vessel agrees to forego the exemption from measurement of certain above-deck spaces which would otherwise be excluded from tonnage. This provision of the Suez rules is complicated. The Panama rules permit no manipulation of light and air and funnel spaces. It is probable that the tonnage resulting from the application of the Panama and Suez rules to propelling-power deductions will not be very widely different, but the Panama rules have the merit of offering no opportunity for securing special favors by manipulation of the measurement rules.

DIFFERENCES IN THE PANAMA AND SUEZ RULES.

The detailed provisions by which the Panama and Suez rules carry out their common principles vary in several particulars. The Suez rules differ from the Panama rules by including in net tonnage certain spaces of minor importance that are not available for the carriage of cargo or passengers. The Suez rules also exempt from measurement some relatively small spaces that are available for passengers or cargo; and the Suez rules, moreover, contain an indefensible limitation upon the deductions allowed for navigation spaces and for spaces occupied by the crew.

The differences in the Panama and Suez rules as applied to vessels of commerce may be stated by considering, first, spaces included in gross tonnage, and second, spaces deducted from gross, to determine net, tonnage.

I. In the following particulars the Suez and Panama rules differ as to the treatment of spaces to be included in gross tonnage:

(*a*) The Suez rules include definitions both of closed-in spaces and of open spaces. This gives shipowners an opportunity to quibble with admeasurers over the application of the definitions to particular spaces. The Panama rules seek to avoid this by defining only closed-in spaces, by enumerating certain spaces that shall be exempted from measurement, and by stipulating that all other closed-in spaces shall be included in the measurement and tonnage.

(*b*) The Panama rules make definite provision for the measurement or exemption of numerous vessel spaces not mentioned in the Suez rules—trunks, turrets, double-bottom compartments, skylights and domes, hatchways, companion houses and ways, and passages and passageways. With the exception of double-bottom compartments, these spaces are measured

under the Suez rules, the spaces being considered to be covered by the general provisions of the rules. The Suez rules, as interpreted for the company, exempt all double-bottom spaces from measurement,[1] while the Panama rules include in the measurement such double-bottom spaces as are used to store reserve or feed water, and such as are available for the stowage of fuel oil or cargo or stores. When double-bottom spaces are used to carry feed water or to store fuel oil, they constitute a part of the usable capacity of the ship, and should logically be included in gross tonnage.

(*c*) In the case of some spaces within superstructures and under decks with "tonnage openings," exclusion from measurement under the Suez rules, as amended by a memorandum issued in 1904, is made to depend upon whether the spaces in question are closed-in or open under the measurement rules of the country of the ship's registry. The memorandum of 1904 (see Appendix XIII) divides such spaces into three categories: (1) spaces closed-in under national rules, (2) spaces open according to the Suez rules and the national rules, and (3) spaces open by the national rules, but closed-in according to the Suez rules. By the memorandum of 1904, the Suez rules include within measurement and tonnage all spaces (category 1) considered as closed-in by the national rules of the country of the ship's registry; and the memorandum further provides that spaces open under the national rules and closed-in under the Suez rules (category 3) shall receive such treatment as to measurement and exemption as is provided for by the memorandum. The exemptions thus given vessels of the third category are those granted by the Panama rules to superstructures and "shelter deck" spaces generally, with the additional provision that the Suez rules, under the 1904 memorandum, exempt from measurement spaces within a closed-in poop up to one-tenth of the length of the vessel, and spaces within a closed-in forecastle up to one-eighth of the length of the ship. As is explained above, the Suez and Panama rules do not accord quite the same treatment to light and air spaces and to spaces framed in around the funnels, nor to the spaces, in the first tier of superstructures, which are located on either side of such light and air casings and smoke funnels.

The Suez rules really divide vessels into two classes:

One class includes vessels having spaces open under the national rules of the ship's registry, but closed-in under the original Suez rules, the treatment of superstructure and "shelter deck" spaces in such vessels being governed by the provisions of the memorandum of 1904. The other class of ships—vessels not having spaces open under the national rules of the ship's registry and closed-in under the Suez rules—come under the provisions of the original rules of 1873. Those rules provided for fewer exemptions than are allowed by the Panama rules. Thus vessels coming under the first of these two classes are granted more exemptions for superstructures and "shelter deck" spaces than the Panama rules allow, while the ships of the second class are given smaller exemptions for such spaces by the Suez rules than by the Panama measurement code.

The Panama rules, in a word, apply the same provisions as to the exemption of spaces in superstructures and under "shelter decks" to all classes of ships, and the exemptions granted are those allowed by the Suez memorandum of 1904, with the exception that the Panama rules do not exempt the space within a closed-in poop up to one-tenth of the length of the vessel nor the space within a closed-in forecastle up to one-eighth of the length of the ship, and with the further exception that light and air and funnel spaces are not given exactly the same treatment by the two sets of rules. The treatment of superstructures and "shelter deck" spaces under the Suez rules seems unnecessarily complicated, and it is believed that the Panama rules treat such spaces in a simpler and more logical manner.

(*d*) As stated above, the Suez rules as interpreted for the company, exempt all double-bottom compartments from measurement, while the Panama rules exempt such spaces only when they can be used, or are used, solely for water ballast. The Panama rules require the measurement of double-bottom spaces that are used to store feed water and such double-bottom compartments as are fitted for the stowage of fuel oil or stores or cargo. By exempting all double-

[1] Consult Appendix XVII, pp. 452 and 460. The interpretation of the rules in practice does not agree with the general instructions to admeasurers issued by the British Board of Trade (see Appendix XIV, p. 419) and by the Bureau of Construction and Repair of the United States Department of the Navy. (See Appendix XVII, p. 443.)

bottom compartments from measurement the Suez rules may result in an understatement of the closed-in capacity and the gross tonnage of vessels.

II. The Suez rules exempt from measurement and from the payment of tolls the spaces occupied by deck loads, while the Panama rules require the measurement of such spaces and the addition of the tonnage of such spaces to the net tonnage upon which tolls and other canal charges based upon tonnage are imposed. The spaces occupied by deck loads unquestionably constitute a part of the capacity of the vessel used for cargo and should be included in the tonnage upon which charges are levied.

III. The Suez and Panama rules differ in the following particulars as regards deductions from gross tonnage:

(*a*) The Suez rules limit the total deductions other than for propelling power—the deductions for crew and navigation spaces—to 5 per cent of the vessel's gross tonnage, while the Panama rules contain no such limitation upon deductions for crew and navigation spaces. The Panama rules enumerate all the spaces regularly required for the accommodation of the crew and for the navigation of the ship, and provisions for the deduction of each of the spaces are limited only by the requirement that "each of the spaces * * * unless otherwise specifically stated shall be subject to such requirements as to marking or designation, size, and use or purpose as are contained in the navigation or registry laws of the several countries, but no space shall be deducted unless the use to which it is to be exclusively devoted has been appropriately designated by official marking." The Panama rules encourage vessel owners to set aside liberal spaces for crew and navigation purposes. The 5 per cent limitation was doubtless without objection in 1873, but it is no longer defensible.

(*b*) The details as to which the Panama and Suez rules differ regarding deductions from gross tonnage may be enumerated as follows:

(1) The Suez rules deduct the spaces occupied by the anchor gear, steering gear, and capstan, the wheelhouse, the chart, lookout, and signal houses, when such spaces are located above deck, while the Panama rules provide for their deduction, whether located above or below deck.

(2) The Suez rules make no provision for the deduction of the spaces set aside for storing of sails, while the Panama rules allow a deduction for sail-room spaces up to $2\frac{1}{2}$ per cent of the gross tonnage of the vessel exclusive of the sail room. It is, however, not probable that any vessels propelled entirely by sails will use either the Panama or Suez Canal.

(3) The Suez rules include in net tonnage the room or rooms devoted to boatswain's stores, while the Panama rules deduct such spaces with a limitation as to the total space to be deducted for such stores.

(4) Neither the Panama nor the Suez rules deduct the space occupied by the donkey engine and boiler when the donkey engine is used to hoist cargo; the Suez rules differ from the Panama rules in not deducting from gross tonnage the spaces occupied by the donkey engine and boiler when located below decks and connected with the main pumps of the ship.

(5) Passageways, under the Suez rules, are deducted only when fitted with lockers, hammocks, etc., for the use of the officers or crew, and when the passageways serve exclusively the quarters of officers or crew. The Panama rules provide for the deduction of passageways when they serve deducted spaces exclusively for the use of officers and crew.

(6) The Suez rules do not deduct the spaces occupied by the cabin of the ship's master. Moreover, the Suez rules deduct the cabin of the ship's doctor only when occupied by the doctor. The Panama rules regularly deduct the cabins set aside for the captain and doctor.

(7) The Suez rules include in net tonnage peak, side, and deep tanks when set aside for water ballast, while the Panama rules deduct all spaces available only for water ballast.

(*c*) Though the Suez rules penalize the commercial use of exempted spaces, they contain no penalty against such use of deducted spaces. The Panama rules specify that if any deducted spaces, other than fuel spaces deducted under the Danube rule, are used to stow cargo, or stores other than boatswain's stores or to accommodate passengers, the spaces shall be added to and become a permanent part of the vessel's net tonnage. However, the practice of the Suez Canal Co. is to add to the net tonnage any deducted spaces that may be used. (Article XV.)

IV. The Suez regulations apply the same measurement rules to warships and to vessels of commerce. The Suez tolls payable by warships are levied upon their net tonnage. The Panama rules do not require the measurement of vessels of war other than Army and Navy transports, colliers, supply ships, and hospital ships. The warship used for fighting purposes can have no real net tonnage. Its size is always indicated by its weight or displacement tonnage. There seems no adequate reason for requiring the measurement of warships other than Army and Navy transports, colliers, supply ships, and hospital ships. Tolls upon warships should be levied upon their displacement tonnage.

The detailed enumeration of the differences in the Panama and Suez measurement rules makes the dissimilarities seem more important than they are in reality. Both sets of rules are based upon the same principles, both seek to make gross tonnage the expression of closed-in capacity, and both make the principal deduction from gross tonnage—that for propelling machinery and fuel—by the same rule. The variations of the Panama rules from the rules of the Suez Canal Co. are, moreover, to some extent due to making the Panama rules more specific by applying them to particular spaces which the International Tonnage Commission of 1873 did not think necessary to enumerate. To some extent the differences in the two sets of rules offset each other.

CHAPTER XIV.

MAIN FEATURES OF THE PANAMA MEASUREMENT RULES.

CHAPTER XIV.

MAIN FEATURES OF THE PANAMA CANAL MEASUREMENT RULES.

VESSELS TO WHICH THE RULES APPLY.

The rates of tolls payable by vessels for the use of the Panama Canal were fixed by the proclamation issued by the President of the United States, November 13, 1912. This proclamation directed the Secretary of War to prescribe rules for the measurement of vessels to determine the tonnage upon which the tolls shall be paid. The proclamation divided vessels into two classes, (1) merchant vessels, with which were associated Army and Navy transports, colliers, hospital ships, and supply ships, and (2) warships other than Army and Navy transports, colliers, hospital ships, and supply ships. The tolls payable by vessels of the first class were fixed at $1.20 per net ton—each 100 cubic feet of actual earning capacity. Vessels without cargo or passengers are allowed a reduction of 40 per cent in the rate of tolls. The charges upon warships were made 50 cents per displacement ton.

The rules are framed with a view to carrying out the President's proclamation. They provide for the determination of the gross and net tonnage of merchant vessels and other ships of the first class above enumerated, and they define and provide for the determination of the displacement tonnage upon which the tolls payable by warships are to be levied.

Article I requires all merchant vessels, whether American or foreign, and all Army and Navy transports, colliers, hospital ships, and supply ships to provide themselves with duly authenticated certificates stating their gross and net tonnage as determined by the Panama measurement rules, and requires all warships, American and foreign, upon applying for passage through the canal, to present duly authenticated displacement scale and curves, stating accurately the tonnage of displacement at each possible mean draft.

Among the vessels included in the first class are supply ships which are defined by Article I of the rules to include Army and Navy ammunition, refrigerator, and distilling ships, as well as Army and Navy vessels used to transport Army and Navy supplies. Colliers are defined to include vessels used to transport coal or fuel oil. The warships to which the Panama rules apply are defined by Article XX to include vessels of war, other than Army and Navy transports, colliers, hospital ships, and supply ships. Before a warship is allowed to pass through the canal, its commander must show that the vessel is of Government ownership and is being employed for military or naval purposes.

PRINCIPLES UPON WHICH THE RULES ARE BASED.

The Panama rules for the determination of the tonnage of merchant vessels are based upon two general principles—that gross tonnage shall be the exact expression of the closed-in capacity of vessels and that net tonnage shall be the equivalent of the space available for the accommodation of passengers and the stowage of cargo and stores; i. e., the actual earning capacity of vessels. To carry out these two principles, the rules state (Art. II) that the gross tonnage shall include the total capacity of vessels, by which is meant the exact cubical contents of all spaces below the upper deck and of all permanently covered and closed-in spaces on or above that deck. The rules further stipulate that gross tonnage shall include not only all permanently covered and closed-in spaces which are or may be used for stowing cargo and stores or for providing shelter and other comfort for passengers or crew, but also such spaces as are used or are intended to be used in navigating and serving the vessel. To make this definition of gross tonnage effective, the rules stipulate that only such spaces as are enumerated in the rules shall be exempted from measurement and that all other spaces shall be considered as closed-in and shall be included in gross tonnage.

To carry out the principle that net tonnage shall approximate as closely as possible the actual earning capacity of vessels for passengers and freight, the rules provide, first, that gross tonnage shall include the entire closed-in capacity of vessels; and, second, that certain enumerated spaces, and only such spaces as are listed in the rules, shall be deducted from gross tonnage to determine net tonnage.

SPACES EXEMPTED FROM, AND INCLUDED IN, MEASUREMENT.

The experience of the vessel measurement authorities of the leading commercial countries and of the Suez Canal Co. shows that it is difficult so to define "closed-in spaces" as definitely to determine what portions of vessels shall be measured and what parts may be exempted from measurement; but, upon the successful determination of what spaces shall be measured and included in gross tonnage, depends the accuracy and fairness of rules for ascertaining net tonnage whether for purposes of national registry or for levying tolls or other charges upon shipping.

The spaces most difficult to define as "open" or "closed-in" are (1) those in superstructures on or above the uppermost full-length deck, and (2) spaces between the uppermost full-length deck and the deck below it, when the uppermost deck has a "tonnage opening" that makes it a "shelter deck." The Panama rules seek to give admeasurers specific guidance regarding the measurement or exemption of these and all other vessel spaces, both by defining "closed-in spaces" and by stating what spaces may be exempted. Exemption from measurement is limited to the spaces designated in the rules.

Permanently covered and closed-in spaces on or above the upper deck are defined by the rules to be spaces which are separated off by decks or coverings or fixed partitions and which add to the capacity that is or may be used for the stowage of cargo and for the berthing and accommodation of the passengers, the officers, or the crew. In order to answer particular questions that have arisen in the measurement of vessels, the rules provide that spaces shall not be exempted from measurement because of a break in a deck nor because of any opening or openings in a deck or in the covering of a space or in the partitions or walls of a space nor because of the absence of a partition when the opening or openings in the deck, partition, or side wall can be closed in, or if the absent partition can be put in place and the spaces be thereby better fitted for the transport of goods or passengers after the spaces have been measured and the tonnage has been determined. The rules also stipulate that the spaces that shall be considered as "permanently closed-in" shall be determined solely by the provisions contained in the Panama rules and not by any definitions or provisions in any other measurement rules.

Spaces on or above the uppermost full-length deck entitled under the rules to exemption from measurement are enumerated in Article IV, section 1. This section provides that spaces under decks or coverings without side walls, i. e., decks having no other connection with the body of the ship than the props necessary for their support, are spaces permanently exposed to the weather and the sea and are not to be included in gross tonnage. The spaces within all permanent superstructures—poops, forecastles, bridges, and other erections—that are to be considered "open" are defined with special care in Article IV, section 1, paragraphs *b* and *c;* and, in order to make the definitions there given as exact and specific as possible, the spaces referred to are illustrated by accompanying figures, 1 to 10.

Certain carefully designated spaces opposite end openings of superstructures are exempted from measurement when the openings are not provided with means of closing and when the space opposite the openings can not be used to shelter other merchandise than cargo or stores that do not require protection from the sea. Spaces between (i. e. "in way of") two opposite openings in the side walls of superstructures may be exempted from measurement when the openings are at least 3 feet in height and are not provided with means of closing.

The Panama rules do not exempt from measurement the between-deck space under an uppermost full-length deck having a "tonnage opening" such as would, under the measurement rules of Great Britain and Germany, entitle the space between such a so-called "shelter deck" and the deck next below it to exemption from measurement. The openings in the so-called "shelter deck" and in the bulkheads subdividing the spaces between that and the next lower deck—openings which under the British and German tonnage laws and regulations entitle the entire between-deck space immediately under the "shelter deck" to exemption from measurement—do not in actual shipping practice prevent the use of the space for stowing dry cargo. The spaces under the "shelter deck" are, in fact, protected from the sea. They are in reality closed-in, and constitute a part of the earning capacity of the vessel.

It was the practice of the British Board of Trade, prior to the decision of the House of Lords in the "Bear" case, in 1875, to include "shelter deck spaces" in gross and net tonnage, and American admeasurers now measure and include in tonnage such spaces when they can be

used to stow dry cargo. The present customs regulations of the United States which control the action of American admeasurers state that:

> Whether for the purpose of measurement a deck is to be regarded as an upper deck or as the shelter to an upper deck is to be determined in each instance both by the character and structural conditions of the erection, and by the purpose to which the between-deck is devoted. * * * If the deck is a continuous deck, fastened down and watertight, sealing up the cylinder formed between the two decks and making it a fit place for the stowage of cargo, like a hold, the deck is to be treated as an upper deck and the space between it and the deck below is to be measured.
>
> If, however, the cylinder is open to the shipment of seas, and the space is not reasonably fit for the carrying of dry cargo, but is used only for cargo generally classed as deck cargo, such as cattle, horses, chemicals, oil in barrels, etc., then, usually, the deck is to be regarded as a shelter deck, and the space as "sheltered space above the upper deck which is under cover and open to the weather; that is, not inclosed," and not to be included in the recorded tonnage.

The Panama rules exempt from measurement only those spaces under a deck with a "tonnage opening" that are between nonclosable openings opposite each other in the side walls of the ship. If the openings in the side walls of the ship are provided with means of closing, no portion of the space under a so-called shelter deck is exempted from measurement. (Art. IV, sec. 2, and fig. 11.)

Until recently the spaces in the double bottom of vessels have been used mainly to carry water ballast. Sometimes the double-bottom compartments under the engine room have been and are used to store reserve or feed water for the boilers. Vessels using oil for fuel now usually carry at least a part of the fuel oil in double-bottom compartments. Under the Panama rules, all spaces used for fuel are included in gross tonnage, and the rules provide (Art. IV, sec. 4) that such spaces within the double bottom as are or may be used for carrying cargo, stores, feed-water, coal, or fuel oil, shall be measured and included in the gross tonnage.

The Panama rules exempt from measurement light and air and funnel spaces above the covering of the first tier of side-to-side erections, if any, upon the uppermost full-length deck, whether it be called the "upper" deck or the "shelter" deck. There are no exceptions to this rule. In all cases, the spaces framed in around the funnels and the spaces required for the admission of light and air into the engine room are included in the engine-room space to the extent that such spaces are below the covering of the first tier of side-to-side erections, if any, upon the uppermost full-length deck. The portion or portions of a poop, bridge, or other structure, above the lowest tier of erections, occupied by the spaces framed in around the funnels or by the spaces required for the admission of light and air into the engine rooms are exempted from measurement, provided such spaces are not used for other than their designated purpose and are reasonable in extent.

The Panama rules, like the national rules and those of the Suez Canal Co., exempt from the gross tonnage the contents of hatchways up to one-half of 1 per cent of the vessel's gross tonnage, exclusive of hatchways. As is true of measurement rules generally, the Panama rules exempt from measurement companionways and companion houses when used solely as companion ways and houses, passageways and passages that serve exempted spaces, and domes and skylights.

If an exempted space, other than an uncovered space or a space that is under a deck that is not inclosed with side walls, is used for passengers, crew, cargo, stores, or fuel, the space must be added permanently to the gross tonnage of the vessel. This provision, Article V, is similar to a rule which the Suez Canal Co. adopted in 1902.

To avoid any possible misunderstanding as to the necessity of measuring spaces on or above the upper deck that are or may be devoted to passenger accommodations, the rules provide, in Article VI, that spaces for the use or possible use of passengers shall not be exempted from measurement except they are spaces under decks or coverings having no other connection with the body of the ship than the props necessary for their support.

The space occupied by deck cargoes is to be added to the tonnage upon which Panama tolls are payable. The rules provide in Article VII, that if any ship carries stores, timber, cattle, or other cargo in any space upon deck not permanently covered or closed-in, the net tonnage upon which the tolls and other charges payable, on the basis of tonnage, for the use of the canal are levied shall be increased by the tonnage of the space occupied, at the time of the payment of the tolls and other charges, by the deck cargo.

In practically all countries vessel spaces are measured by rules which were formulated by George Moorsom for the British Government and which were incorporated in the British Merchant Shipping Act of 1854, and are now a part of the present British Merchant Shipping

Act of 1894 as amended to date. The Panama measurement rules provide that the cubical contents of the spaces included by the rules in gross tonnage may be ascertained, in any country where vessels are measured by applying the Moorsom system, as for purposes of national registry. The Panama rules, however, provide that should vessels be measured for Panama Canal tonnage in any country where the measurement rules are not substantially similar to the Moorsom rules as embodied in Article IX of the Panama rules, the officials making the measurement shall apply the Moorsom system of measurement as set forth in the Panama rules. These provisions will doubtless reduce the amount of labor required in measuring vessels for Panama Canal tonnage. Most spaces in vessels are included in gross tonnage by all measurement rules, and the cubical contents of all such spaces are determined by the Moorsom system, which is substantially the same in all countries. It is expected that it will be necessary, in the case of most vessels, to measure only such spaces as were exempted in applying the national registry rules but which are included in the gross tonnage by the Panama rules.

SPACES DEDUCTED FROM GROSS TONNAGE.

The spaces that may be deducted from gross tonnage to determine the net tonnage of vessels not propelled by engines are enumerated in Article X of the rules. Few, if any, vessels depending entirely upon wind propulsion will use the Panama Canal; but it is probable that barges and unrigged craft will be towed through the canal. Their net tonnage is to be determined by making the deductions listed in Article X. The deductions allowed for propelling-power spaces in vessels propelled by engines are stated in Articles XII, XIII, and XIV. The deductions permitted engine-driven vessels are both those enumerated in Article X and those allowed for propelling power by Articles XII and XIII, or XII and XIV. The only deductions other than for propelling power that may be made from gross tonnage are enumerated in Article X, sections 1 to 10; and Article XI stipulates that no space, other than fuel spaces deducted under Article XIII, shall be deducted unless the use to which it is to be exclusively devoted has been appropriately designated by official marking. The spaces, however, are not necessarily to be marked by the officials that measure vessels for Panama Canal certificates, it being provided by the rules that spaces shall be subject to such requirements as to marking or designation, and use or purpose as are contained in the navigation or registry laws of the several countries.

To give added definiteness to the deductions allowed by Article X, one paragraph of the article states that spaces for the use or possible use of passengers shall not be deducted except as specifically provided for in sections 1 to 10 of Article X. It is also stipulated in the same article that spaces available for the stowage of stores (other than boatswain's stores) or cargo shall not be deducted from gross tonnage; and, in the case of Army and Navy transports, colliers, supply ships, and hospital ships, as defined in Article I of the rules, the term "stores (other than boatswain's stores) or cargo" shall include, in addition to goods or cargo ordinarily carried as freight on vessels of commerce, an enumerated list of articles.

Under all rules for the determination of net tonnage, the largest deductions from gross tonnage are for machinery and fuel spaces. The Panama rules as to propelling-power deductions are practically the same as those of the Suez Canal Co., i. e., in vessels that do not have fixed bunkers or fuel compartments the deduction is to be the spaces actually occupied by machinery increased, for screw-propelled vessels, by 75 per cent, and, for vessels with paddle wheels, by 50 per cent. Vessels which have fixed coal bunkers or fuel compartments may have the propelling-power deductions made by this (the Danube) rule, or may have the deductions made by actual measurement of the spaces occupied by propelling machinery and fuel, provided the fixed bunkers and fuel compartments have been certified by official marking to be for the stowage of the vessel's fuel.

The main difference between the Panama rule for propelling-power deduction and that of the Suez Canal Co. concerns the treatment of light and air spaces and framed-in funnel spaces above the engine and boiler rooms. In the Panama rules, in all cases, the spaces that are framed in around the funnels and the spaces for light and air are included in the engine room to the extent that such spaces are below the covering of the first tier of side-to-side erections, if any, upon the uppermost full-length deck, whether that deck is or is not fitted with a "tonnage opening." The spaces above the deck or covering of the first tier of side-to-side erections upon the uppermost full-length deck are exempted from measurement.

The spaces included in the engine room, under the Panama rules, are specifically stated in Article XIII. The engine-room spaces include the engine room itself and the boiler room, together with the spaces strictly required for the working of the engines and boilers with the addition of the spaces taken up by shaft trunks (in vessels with screw propellers), the spaces which inclose the funnels and the spaces which are within the light and air casings up to the uppermost full-length deck, or to the covering of the first tier of side-to-side erections, if any, upon that deck, and the spaces occupied by the donkey engine and boiler when the donkey engine and boiler are within the boundary of the main engine room or of the light and air casing above it, and when used in connection with the main propelling machinery.

The cubical contents of the engine-room spaces are to be determined by the method of measurement included in the Moorsom system of measurement. Presumably, ships measured for national registry will have had the contents of their engine rooms measured by applying this method. The method is, however, included in the Panama rules to be applied to the measurement of the engine-room spaces when those spaces have not been measured by rules substantially the same as the method stated in the Panama rules.

The method of measuring fuel spaces when deductions are made by the actual measurement of spaces occupied by machinery and fuel are stated in Article XIV; and, in order to secure absolute uniformity in measurement practice, Article XIV stipulates what spaces shall be measured when propelling-power deductions are made by actual measurement. The spaces to be measured include the engine room as defined in Article XIII, and, in addition thereto, fixed coal bunkers, fuel-oil tanks, and such double-bottom compartments as are fitted for the stowage of fuel oil, provided such bunkers, tanks, and fuel comparments have been certified by official marking to be spaces for the vessel's fuel. The Panama rules also provide, as do the regulations issued by the British Board of Trade, that the bunkers measured for fuel deduction shall include only those bunkers that are absolutely permanent, from which the coal can be trimmed directly into the engine room or stokehole, and into which access can be obtained only through the ordinary coal chutes on deck and from doors opening into the engine room or stokehole. Thwartship bunkers that can be in any way extended are not to be included in the measurement for deductions.

The Panama rules apply the same method of determining propelling-power deductions to vessels equipped with internal-combustion engines as is applied to vessels having steam engines, i. e., the propelling-power deduction in the case of internal-combustion engines may be made either by the Danube rule or by the actual measurement of machinery and fuel spaces.

The total deductions for machinery and fuel spaces, whether made in accordance with the Danube rule or by the actual measurement of the spaces deducted, shall not exceed 50 per cent of the gross tonnage. This rule is the same as that contained in the Suez Canal Co.'s regulations and results in a maximum percentage deduction that is practically equivalent to the percentage which the British measurement rules permit after the 1st of January, 1914, when the deductions under the British rule are to be limited to 55 per cent of the gross tonnage remaining after all other deductions have been made. In the Panama, as in the Suez and other measurement, rules, tugs used exclusively as tugs are exempted from this limitation.

In the determination of net tonnage, no space shall be deducted unless it has been included in gross tonnage (Art. XV). This provision is to be found in most measurement rules.

The use of the whole or any portion of a deducted space, other than fuel spaces deducted in accordance with the Danube rule, to stow cargo of any kind or stores other than boatswain's stores or to provide passenger accommodations shall be evidence that the entire space thus wholly or partially occupied is a part of the actual earning capacity of the ship and the entire space shall be added to, and become a permanent part of, the net tonnage upon which Panama Canal tolls shall be collected.

MEASUREMENT OFFICIALS AUTHORIZED TO ISSUE PANAMA CANAL TONNAGE CERTIFICATES.

The rules provide, in Articles XVI to XVIII, that vessels may be measured for Panama Canal tonnage certificates, and that the certificates may be issued by, (1) such officials as are authorized to measure vessels at ports of the United States for purposes of national registry, (2) such officials as are authorized in the several foreign countries to measure vessels for national

registry, and (3) such other officials as may be authorized by the President of the United States, or those acting for him, to issue Panama Canal tonnage certificates.

It is expected that new vessels, American and foreign, will be measured for Panama Canal tonnage certificates at the time the vessels are measured for national registry, and that such vessels as are in service at the time the Panama Canal is opened will be measured for Panama Canal tonnage when at their home ports, before clearing therefrom for voyages that will take them through the Panama Canal. Should any vessel other than a warship arrive at the canal without a Panama Canal tonnage certificate, it will need to be measured by the officials at the Isthmus before the ship is allowed to pass through the canal or to clear therefrom.

All tonnage certificates presented by vessels at the canal are subject to correction by the officials authorized by the President of the United States, or by those acting for him, to administer the Panama measurement rules. Tonnage certificates presented by the masters of vessels upon application for passage through the canal may be changed by the officials at the canal in so far as may be necessary to make the certificates and the tonnage of vessels conform to the requirements of the Panama measurement rules. The tonnage certificates issued by the measurement authorities of all countries must correspond in substance and form to the Panama Canal tonnage certificate accompanying, and forming a part of, the Panama measurement rules. It is expected that the measurement authorities of foreign countries will issue, in their respective languages, Panama Canal tonnage certificates corresponding in substance and form to the official Panama Canal tonnage certificate appended to the Panama measurement rules.

If any vessel applying for passage through the Panama Canal has deck cargo on board, the space occupied by that cargo shall be measured by the officials at the Isthmus, and the tonnage of the space thus occupied shall be added to the vessel's net tonnage upon which tolls are paid. Article VII of the rules designates what shall be considered as deck cargo, and states the method to be followed in measuring the spaces occupied by such cargo.

RULES FOR DETERMINING THE ACTUAL DISPLACEMENT OF VESSELS OF WAR OTHER THAN ARMY AND NAVY TRANSPORTS, COLLIERS, SUPPLY SHIPS, AND HOSPITAL SHIPS.

Panama tolls upon warships other than Army and Navy transports, colliers, supply ships, and hospital ships are payable upon the actual displacement of the vessels at the time of their application for passage through the canal, and before the vessels have taken on such fuel, stores, or supplies as may be purchased after arrival at the canal. "Warships," in the meaning of the Panama rules, are vessels of war, other than Army and Navy transports, colliers, hospital ships, and supply ships (as supply ships and colliers are defined in Article I of the rules). Warships must be vessels of Government ownership that are being employed by their owners for military or naval purposes.

The actual displacement of a warship draft upon arrival at the canal shall be ascertained from the official document or documents which a vessel of war regularly carries—its curve of displacement, its curves for addition to displacement for change of trim, and its displacement scale stating the tonnage of displacement at each possible mean draft. Warships are to pay Panama Canal tolls on the tonnage of actual displacement as shown by these official documents, duly authenticated; and if the tonnage of displacement is stated in metric tons, the tonnage is to be changed to English long tons.

If for any reason, which the Governor of the Panama Canal or the official authorized to act for him deems to be satisfactory, the commander of a warship applying for passage through the Panama Canal is unable to present a duly certified document from which the vessel's actual displacement tonnage may be read or calculated, the measuring officials at the canal shall determine the vessel's approximate tonnage of displacement from such reliable data as may be available or by taking such dimensions of the vessel and using such approximate methods as may be considered necessary and practicable.

BIBLIOGRAPHICAL NOTE AND LIST OF PRINCIPAL WORKS CONSULTED.

BIBLIOGRAPHICAL NOTE AND LIST OF PRINCIPAL WORKS CONSULTED.

Tonnage and vessel measurement are large subjects concerning which there is much printed information. The list here presented includes the titles of only the principal works used in preparing this report; and the books, reports, and papers consulted furnished only a part of the data required in the preparation of the report, much information having been obtained by correspondence and conference with shipowners, the builders of ships and engines, and government officials in charge of vessel measurement. Especially valuable information was given by the Principal Surveyor to Lloyd's Register for the United States and Canada and by the Chief of the Bureau of Construction and Repair of the Navy Department. The United States Commissioner of Navigation, Hon. E. T. Chamberlain, has been frequently consulted. His knowledge and experience were of much assistance.

The leading printed sources consulted may be conveniently grouped with reference to three subjects: (1) Tonnage and vessel measurement, (2) types of vessels and ship construction, and (3) internal-combustion engines and oil-burning steam engines.

The materials on tonnage and vessel measurement are scattered and fragmentary, and have been printed at different times since 1850. The measurement rules and instructions of the leading countries and of the Suez Canal Co. are reproduced in the appendices of this report. The appendices also contain the Report of the International Tonnage Commission of 1873, the Report of the British Royal Commission on Tonnage of 1881, and extracts from Lieut. V. Béret's Étude Sur le Juageage. Béret's work contains the only recent comparison of the leading codes of measurement rules. It also presents briefly the history of measurement.

Among the principal historical sources are the Report, Minutes of Evidence, and Appendices to the Report of the British Royal Commission on Tonnage of 1881, the Report and Minutes of Evidence of the Select Parliamentary Committee on Tonnage of 1874, and the correspondence of the British delegates and Procés-Verbaux of the meetings held by the International Tonnage Commission of 1873. The Nautical Magazine published a series of 10 articles on "Tonnage, Past and Present," during 1889 and 1890, which contain much historical data. Good, but brief, historical chapters may be found in White's Manual of Naval Architecture, and in Lloyd's Calendar of 1911.

Of the books on types of vessels and on ship construction, in their bearing upon tonnage, special mention may be made of Walton's Present-Day Shipbuilding; Capt. Paasch's Marine Dictionary (From Keel to Truck); Holm's Practical Shipbuilding; and Bile's The Design and Construction of Ships. The types, construction, and tonnage of warships are well described in Attwood's War Ships, Robinson's Naval Construction, and in the Instructions for Standard Ship Calculations of the United States Bureau of Construction and Repair.

Internal-combustion marine engines and oil-burning steam marine engines are of recent development. The references given below include the titles of several books on ordinary gas engines; but the up-to-date and most instructive material on the Diesel and other internal-combustion oil engines for seagoing vessels is to be found mainly in technical journals and in the proceedings of the associations of marine engineers and of naval architects. Special mention, however, should be made of Chalkley's excellent book on Diesel Engines for Land and Marine Work (1912). Technical papers of special value are to be found in the proceedings of the Institute of Marine Engineers of Great Britain (1910–11 and 1911–12), and the Transactions of the Institution of Naval Architects of Great Britain (1911 and 1912). An instructive address by Dr. Rudolf Diesel on the "Present Status of the Diesel Engine in Europe," has been printed in pamphlet form. These and other works on oil engines, however, treat tonnage questions only

incidentally. Most of the information in Chapter X of the present report was obtained from correspondence with engine builders, shipbuilders and vessel owners.

The following list is not given as a complete bibliography on tonnage and vessel measurement, but as a convenient compilation of the leading printed sources consulted in the preparation of this report.

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PART III.

RULES FOR THE MEASUREMENT OF VESSELS FOR THE PANAMA CANAL.

RULES FOR THE MEASUREMENT OF VESSELS FOR THE PANAMA CANAL.

All vessels to present tonnage document at canal.

ARTICLE I. All vessels, American and foreign, except warships, including vessels of commerce and Army and Navy transports, colliers, supply ships, and hospital ships, applying for passage through the Panama Canal shall present a duly authenticated certificate stating the vessel's gross and net tonnage as determined by these rules. Vessels of commerce, Army and Navy transports, colliers, supply ships, and hospital ships without such certificate shall, before passing through the canal, or before being allowed to clear therefrom, be measured, and shall have their gross and net tonnage determined in accordance with these rules.

All warships, American and foreign, other than transports, colliers, supply and hospital ships, shall present duly authenticated displacement scale and curves stating accurately the tonnage of displacement at each possible mean draft.

Vessels designated as "supply ships" and "colliers."

It is to be understood that "supply ships" shall include Army and Navy ammunition ships, refrigerator ships, distilling ships, repair ships, submarine tenders, and destroyer tenders, as well as Army and Navy vessels used to transport general Army and Navy supplies; and that "colliers" shall include Army and Navy vessels used to transport coal or fuel oil.

RULES APPLYING TO VESSELS OF COMMERCE, ARMY AND NAVY TRANSPORTS, COLLIERS, SUPPLY SHIPS, AND HOSPITAL SHIPS.

GROSS TONNAGE.

What shall be included in gross tonnage.

ART. II. Gross tonnage as determined by these rules shall express the total capacity of vessels, i. e., the exact cubical contents of all spaces below the upper deck and of all permanently covered and closed-in spaces on or above that deck, excepting such spaces as may be hereinafter permitted as exemptions from measurement. Gross tonnage shall include not only all permanently covered and closed-in spaces which are or may be used for stowing cargo and stores or for providing shelter and other comfort for passengers or crew, but also such spaces as are used, or are intended to be used, in navigating and serving the vessel.

Only such spaces as are specifically mentioned in Article IV, below, shall be exempted from measurement. All other spaces shall be considered as closed-in and shall be included in gross tonnage.

What shall be considered permanently covered and closed-in spaces.

ART. III. By permanently covered and closed-in spaces on or above the upper deck are to be understood all those which are separated off by decks or coverings, or fixed partitions, and which, therefore, represent an increase of capacity that is or may be used for the stowage of cargo, or for the berthing and accommodation of the passengers, the officers, or the crew. No break in a deck, nor any opening or openings in a deck or the covering of a space or in the partitions or walls of a space, nor the absence of a partition shall prevent a space from being measured and comprised in gross tonnage if the opening or openings in the deck, partition, or side wall can be closed in, or if the absent partition can be put in place, after admeasurement and the spaces thus closed in be thereby better fitted for the transport of goods or passengers.

In the case of a vessel having a "trunk" or "turret", the deck forming the covering of the trunk or turret shall be considered the upper deck, and all spaces below that deck within the trunk or turret shall be considered as covered and closed-in. The space within the turret or trunk shall be measured as are other between-deck spaces.

Spaces considered as "permanently closed-in" and spaces permitted to be exempted from measurement shall be determined solely by the provisions contained in these rules, and not by any definitions or provisions contained in the measurement rules or regulations of any country.

Spaces exempted from measurement and gross tonnage.

ART. IV. The following spaces shall be exempted from measurement and shall not be included in the gross tonnage, and no other spaces shall be exempted:

SECTION 1. Spaces on or above the upper deck not permanently covered or closed-in, or which may not be readily covered or closed-in. In the application of this rule it will be understood that—

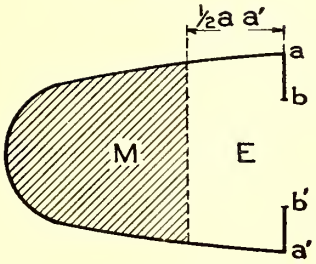
(*a*) Spaces under decks or coverings having no other connection with the body of the ship than the stanchions necessary for their support are not spaces separated off, but are spaces permanently exposed to the weather and the sea and are not to be included in the gross tonnage.

(*b*) A space within a poop, forecastle, bridge house, or other "permanently covered and closed-in" superstructure or erection may be considered as not permanently covered or closed-in, and may consequently be excluded from tonnage, if the space is opposite an end opening which is without a coaming and has no headplates or planks and is not provided with means of closing, and which opening has a breadth equal to or greater than half the breadth of the deck at the line of the opening, and if the space opposite the opening can not be used to shelter other merchandise than cargo or stores that do not require protection from the sea. If the opening is fitted with a coaming, the space within it is to be included in the gross tonnage. This provision shall be so applied as to exempt from measurement only the space between the actual end opening and a line drawn parallel to the line or face of the opening at a distance from the opening equal to one-half the width of the deck at the line of the opening; provided, that any closed-in space between the open face and the line drawn parallel to it shall be measured. The remainder of the space within a poop, forecastle, bridge house, or other superstructure or erection shall be considered as available for the accommodation of cargo or stores, of passengers or of the ship's personnel, and shall be measured and included in the gross tonnage. (See Figs. 1, 2, and 3.)

Should the open space within a poop, forecastle, bridge house, superstructure, or erection between the end opening and a parallel line distant from the opening by half the breadth of the deck become, because of any arrangement, of less width than half the breadth of the deck, then only the space between the line of the end opening and a parallel line drawn through the point where the athwartship width of the open space within the poop, forecastle, bridge house, superstructure, or erection becomes equal to, or less than, half the breadth of the deck shall be exempted from measurement. (See Figs. 4, 5, 6, and 7.) The remainder of the space within the poop, forecastle, bridge house, superstructure, or erection is to be included in the gross tonnage.

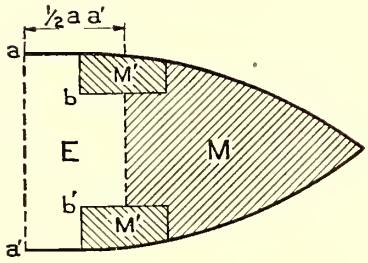
When two erections extending from side to side of the ship are separated by an interval the fore-and-aft length of which is less than the least half breadth of the deck in way of such interval, then whatever be the breadth of the permanent end openings of the erections, the entire erections, less the interval separating them, shall be measured and included in the gross tonnage. (See Fig. 8.)

FIG. 1.—Poop.



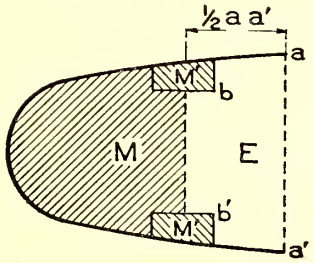
$bb' > \frac{1}{2}\ aa'$.
E = space exempted.
M = space measured.

FIG. 3.—Forecastle.



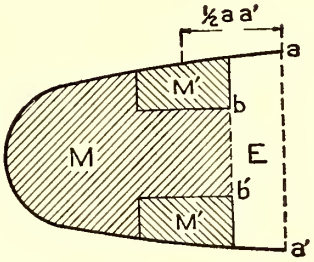
$bb' > \frac{1}{2}\ aa'$.
E = space exempted.
M′ = closed-in houses, measured.
M = space measured.

FIG. 2.—Poop.



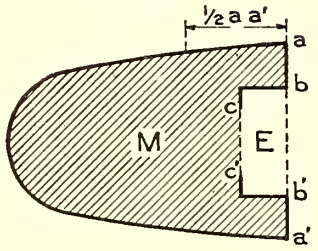
$bb' > \frac{1}{2}\ aa'$.
E = space exempted.
M′ = closed-in houses, measured.
M = space measured.

FIG. 4.—Poop.



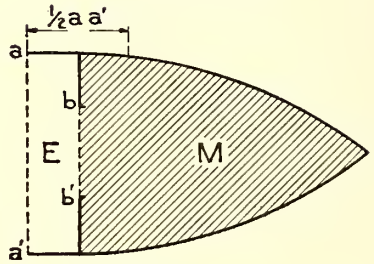
$bb' < \frac{1}{2}\ aa'$.
E = space exempted.
M′ = closed houses, measured.
M = space measured.

FIG. 5.—Poop.



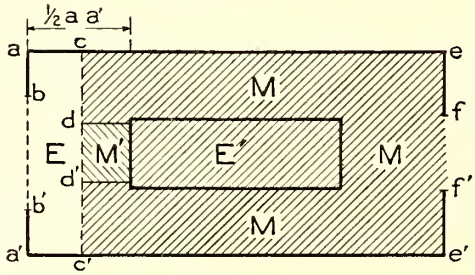
$bb' > \frac{1}{2}\, aa'$.
$cc' < \frac{1}{2}\, aa'$.
E = space exempted.
M = space measured.

FIG. 6.—Forecastle.



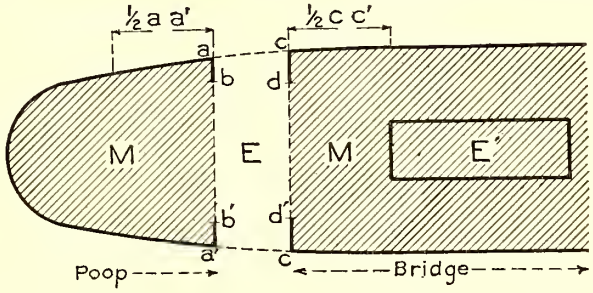
$bb' < \frac{1}{2}\, aa'$.
E = space exempted.
M = space measured.

FIG. 7.—Bridge.



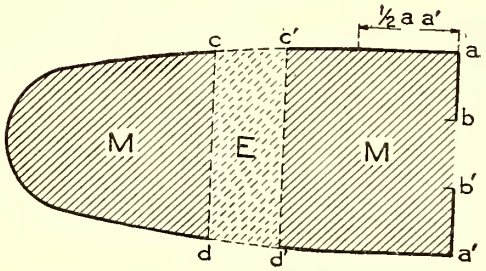
$bb' > \frac{1}{2}\, aa'$.
$cd < \frac{1}{2}\, aa'$.
$c'd' < \frac{1}{2}\, aa'$.
$ff < \frac{1}{2}\, ee'$.
E = space exempted.
E′ = light and air and funnel space in lowest tier of erections, measured under Art. IV, Sec. 3.
M = space measured.
M′ = closed house, measured.

FIG. 8.—Poop and Bridge with interval less than ½ the least half breadth of the Deck in way of interval.



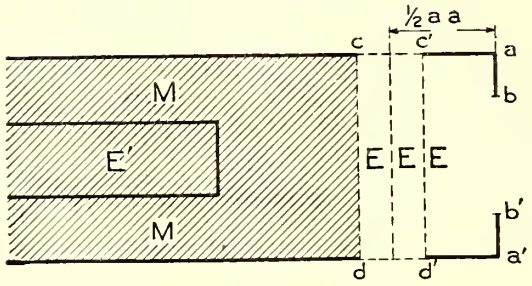
$ac < \frac{1}{2} aa'$.
$a'c' < \frac{1}{2} aa'$.
$bb' > \frac{1}{2} aa'$.
$dd' > \frac{1}{2} cc'$.
M=spaces measured.
E=space exempted.
E′=light and air and funnel space in lowest tier of erections, measured under Art. IV, Sec. 3.

FIG. 9.—Poop.



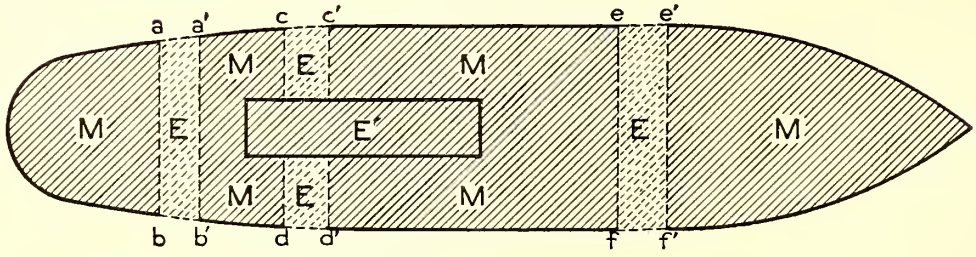
cc′ and dd′=side openings under deck covering.
E=space exempted.
$bb' < \frac{1}{2} aa'$.
M=spaces measured.

FIG. 10.—Bridge.



$bb' > \frac{1}{2} aa'$.
cc′ and dd′=side openings.
E=spaces exempted.
M=space measured.
E′=light and air and funnel space, in lowest tier of erections, measured under Art IV, Sec. 3.

FIG. 11.—Continuous deck with opposite side openings.



(aa′) (bb′) (cc′) (dd′) (ee′) (ff′) = side openings.
E = spaces exempted opposite side openings below continuous deck.
M = spaces measured.
E′ = light and air and funnel space, measured under Art. IV, Sec. 3.

(*c*) In a poop, forecastle, side-to-side bridge house, or other "permanently covered and closed-in" superstructure or side-to-side erection the space directly in way of opposite openings, the height of which is at least 3 feet, in the side walls of the ship not provided with means of closing and corresponding to each other in the opposite walls of the ship shall be exempted. (See Figs. 9 and 10.)

SEC. 2. Spaces in way of opposite side openings at least 3 feet in height not provided with means of closing shall be exempted. In the case of a continuous deck with one or more deck openings (usually designated as tonnage openings) that may be so closed as to permit cargo or stores to be carried in the space under the deck, or under portions thereof, only the spaces under such a deck that are exactly in way of opposite openings at least 3 feet in height in the side walls of the ship not provided with means of closing and corresponding to each other in the opposite walls of the ship shall be exempted; and the remaining spaces under such a deck shall be measured and included in gross tonnage. In case the openings in the side walls of the ship are provided with means of closing, no portion of the space under such a deck shall be exempted. (Fig. 11.)

SEC. 3. The spaces framed in round the funnels and the spaces required for the admission of light and air into the engine rooms shall be exempted from measurement to the extent that such spaces are above the deck or covering of the first or lowest tier of side-to-side erections, if any, on the upper deck. A deck with one or more deck openings (usually designated as tonnage openings) that may be so closed as to permit cargo or stores to be carried in the space under the deck or portions thereof is to be considered as the upper deck, provided that no space beneath it abreast side openings is exempted under the provisions of section 2. There shall, however, be measured and included within gross tonnage the spaces situated within closed-in side-to-side erections on the upper deck, spaces framed in round the funnels and those required for the admission of light and air to the extent that such light and air and funnel spaces are below the deck or covering of the first or lowest tier of such side-to-side erections on the upper deck. There shall be exempted from the measurement of any superstructure or erection situated above the first or lowest tier of side-to-side erections on the upper deck such portion or portions thereof as are occupied by the spaces framed in round the funnels or by the spaces required for the admission of light and air into the engine rooms. Such exempted spaces must not be used for any other than their designated purpose and must be reasonable in extent.

SEC. 4. Space or spaces between the inner and outer plating of the double bottom of a vessel that are so inclosed and that have such openings as to make them usable only for water ballast shall be exempted from measurement; but such spaces within the double bottom as are or may be used for carrying cargo, stores, feed water, coal, or other fuel shall be measured and included in the gross tonnage.

SEC. 5. The cubical contents of hatchways shall be obtained by multiplying the length and breadth together and the product by the mean depth taken from the top of beam to the underside of the hatch. From the aggregate tonnage of the hatchways there shall be deducted one-half of 1 per cent of the vessel's gross tonnage, exclusive of hatchways, and only the remainder shall be added to the gross tonnage of the ship, exclusive of the tonnage of the hatchways.

SEC. 6. Companionways and companion houses shall be exempted when used solely as companionways or companion houses. When used as smoking rooms or for any other purposes than companionways or companion houses, the parts so used shall be measured and included in gross tonnage.

SEC. 7. Domes and skylights shall be exempt from measurement. When there is an opening in the floor of a superstructure immediately below a skylight, the exemption shall include the space between the skylight and the opening in the floor of the superstructure immediately under the skylight. The remainder of the superstructure shall be included in the measurement. The space, in addition to the skylight, that may be exempted by this rule is that indicated by A, B, C, D in the following drawing:

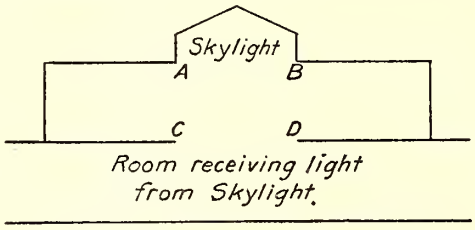


FIG. 12.—Open space under skylight.

Exempted spaces, if used, must be added to gross tonnage.

ART. V. Should a vessel at any time stow cargo of any kind, bunker coal or other fuel, or stores of any description in any portion whatever of any exempted space, except spaces exempted under Art. IV, Sec. 1, Par. (b) and spaces on open decks not permanently covered, or upon decks as defined in Art. IV, Sec. 1, Par. (a), of these rules, the whole of that space shall be measured and added to the gross tonnage, and the space shall not thereafter be exempted from measurement.

Spaces available for passengers not to be exempted.

ART. VI. Spaces for the use or possible use of passengers shall not be exempted from measurement except as stated in Article IV, section 1, paragraph (*a*).

In case of Army and Navy transports, colliers, supply ships, and hospital ships as defined in Article I, the term "passengers" shall include all officers, enlisted men, and other persons who are not assigned to duty and who are not duly inscribed on the ship's rolls.

Tonnage upon which charges are payable shall be increased by space occupied by cargo carried upon deck in spaces not permanently covered and closed in.

ART. VII. If any ship carries stores, timber, cattle, or other cargo in any space upon an open deck not permanently covered or in spaces exempted under Art. IV, Sec. 1, Pars. (a) and (b) of these rules, all tolls and other charges payable on the vessel's net tonnage shall be payable upon the vessel's net tonnage (as defined below in Articles X and XII) increased by the tonnage of the space occupied (at the time at which the tolls or other charges become payable) by the goods carried upon deck and not permanently covered or closed-in. The deck space occupied by the goods thus carried shall be determined at the time of the application of the vessel for passage through the canal and shall be deemed to be the space limited by the area occupied by the goods and by straight lines inclosing a rectangular space sufficient to include the goods. The tonnage of the space occupied by the goods shall be ascertained in the manner prescribed below by Article IX, Rule I, for the measurement of poops or other closed-in spaces.

Nothing in this article shall in any manner affect the provisions of Articles II, III, and IV.

Measurement of the cubical contents of spaces may be by the Moorsom system in each country, or by the Moorsom system as prescribed in these rules.

ART. VIII. The cubical contents of the spaces included, by these rules, in gross tonnage may, in any country where the Moorsom system of measurement has been adopted, be ascertained under that system as applied in measuring vessels for national registry, provided that system is substantially similar to the Moorsom system of measurement as set forth in Article IX of these rules.

ART. IX. In countries that have not adopted the Moorsom system of measuring spaces within vessels, the cubical contents of any of the spaces included in gross tonnage shall be ascertained according to the Moorsom system as set forth in the following rules: Rule I for the measurement of empty vessels; Rule II for laden vessels; Rule III for open vessels.

Rules for the measurement of contents of spaces.

RULE I.—*For measuring the gross tonnage of empty vessels.*

Rule for the measurement of empty vessels.

SECTION 1. The length for the admeasurement of ships having one or more decks is taken on the tonnage deck, which is—

(*a*) The upper deck for vessels having one or two decks.

(*b*) The second deck from below for vessels having more than two decks.

Measure the length of the ship in a straight line along the upper side of the tonnage deck from the inside of the inner plank (average thickness) at the side of the stem to the inside of the midship stern timber or plank there, as the case may be (average thickness), deducting from this length what is due to the rake of the bow in the thickness of the deck and what is due to the rake of the stern timber in the thickness of the deck, and also what is due to the rake of the stern timber in one-third of the round of the beam; divide the length so taken into the number of equal parts required by the following table, according to the class in such table to which the ship belongs:

Class 1: Ships of which the tonnage deck is, according to the above measurement, 50 feet long or under, into 4 equal parts.

Class 2: Ships of which the tonnage deck is, according to the above measurement, above 50 feet long and not exceeding 120 feet, into 6 equal parts.

Class 3: Ships of which the tonnage deck is, according to the above measurement, above 120 feet long and not exceeding 180 feet, into 8 equal parts.

Class 4: Ships of which the tonnage deck is, according to the above measurement, above 180 feet long and not exceeding 225 feet, into 10 equal parts.

Class 5: Ships of which the tonnage deck is, according to the above measurement, above 225 feet long, into 12 equal parts.[1]

In the case of a break or breaks in a double-bottom for water ballast, the length of the vessel is to be taken in parts according to the number of breaks, and each part divided into a number of equal parts according to the class in the above table to which such length belongs.

SEC. 2. Then the hold being first sufficiently cleared to admit of the required depths and breadths being properly taken, find the transverse area of the ship at each point of division of the length or each point of division of the parts of the length, as the case may require, as follows: Measure the depth at each point of division, from a point at a distance of one-third of the round of the beam below the tonnage deck, or, in case of a break, below a line stretched in continuation thereof, to the upper side of the floor timber (upper side of the inner plating of the double bottom) at the inside of the limber strake, after deducting the average thickness of the ceiling which is between the bilge planks and the limber strake, subject, however, to the provisions of these rules, Article IV, section 4, regarding the measurement or exemption of double-bottom spaces. In the case of a ship constructed with a double-bottom for water ballast if the space between the inner and outer plating thereof is not available for the carriage of cargo, stores, feed-water, coal, or other fuel, then the depth shall be taken to be the upper side of the inner plating of the double-bottom, and that upper side shall, for the purposes of measurement, be deemed to represent the floor timber of the vessel. This rule for measuring the depth of the hold applies to double-bottom ships having top of double bottom *not* horizontal.

[1] A greater number of divisions is permissible provided there be an even number of divisions.

If the depth at the midship division of the length does not exceed 16 feet, divide each depth into 5 equal parts; then measure the inside horizontal breadth at each of the four points of division, and also at the upper point of the depth, extending each measurement to the average thickness in that part of the ceiling which is between the points of measurement. Number these breadths from above (i. e., numbering the upper breadth 1, and so on down to the fifth breadth); multiply the second and fourth by 4, and the third by 2; add these products together, and to the sum add the first breadth and the fifth. Multiply the quantity thus obtained by one-third of the common interval between the breadths, and the product shall be deemed the transverse area of the upper part of the section; then find the area between the fifth and lower point of the depth by dividing the depth between such points into four equal parts, and measure the horizontal breadths at the three points of division and also at the upper and lower points, and proceed as before, and the sum of two parts shall be deemed to be the transverse area; but if the midship depth exceed 16 feet, divide each depth into 7 equal parts instead of 5, and measure, as before directed, the horizontal breadths at the six points of division, and also at the upper point of the depth; number them from above, as before; multiply the second, fourth, and sixth by 4, and the third and fifth by 2; add these products together, and to the sum add the first breadth and the seventh. Multiply the quantity thus obtained by one-third of the common interval between the breadths, and the products shall be deemed the transverse area of the upper part of the section; then find the lower part of the area as before directed, and add the two parts together, and the sum shall be deemed to be the transverse area.

This section applies to vessels with double bottoms, the tops of which have a rise from the middle line to each side. In vessels in which the top of the double bottom is horizontal, or in which there is no double bottom, the depths are to be divided by 4 or 6 (instead of 5 or 7), according as their midship depths do not or do exceed 16 feet respectively. In such cases no subdivision of the lower part is to be made.

SEC. 3. Number the transverse sections or areas respectively 1, 2, 3, etc., No. 1 being at the extreme limit of the length at the bow, or of each part of the length, and the last number at the extreme limit of the length at the stern or the extreme limit at the after end of each part of the length; then, whether the length be divided according to the table into 4 or 12 parts, as in classes 1 and 5, or any intermediate number, as in classes 2, 3, and 4, multiply the second and every even-numbered area by 4, and the third and every odd-numbered area (except the first and last) by 2; add these products together, and to the sum add the first and last, if they yield anything; multiply the quantity thus obtained by one-third of the common interval between the areas, and the product will be the cubical contents of the space, or cubical contents of each part if the ship is measured in parts under the tonnage deck. The tonnage of this volume is obtained by dividing it by 100, if the measurements are taken in English feet, and by 2.83 if the measurements are taken in meters. The multiplier 0.353 may be used instead of the divisor 2.83.

SEC. 4. If the ship has a third deck the tonnage of the space between it and the tonnage deck shall be ascertained as follows: Measure in feet the inside length of the space at the middle of its height from the plank at the side of the stem to the lining on the timbers at the stern, and divide the length into the same number of equal parts into which the length of the tonnage deck is divided, as above directed; measure (also at the middle of its height) the inside breadth of the space at each of the points of division, also the breadth at

the stem and the breadth at the stern; number them successively 1, 2, 3, etc., commencing at the stem; multiply the second and all the other even-numbered breadths by 4, and the third and all the other odd-numbered breadths (except the first and last) by 2; to the sum of these products add the first and last breadths; multiply the whole sum by one-third of the common interval between the breadths, and the result will give in superficial feet the mean horizontal area of the space; measure the mean height of the space, and multiply by it the mean horizontal area, and the product will be the cubical contents of the space; divide this product by 100 (or by 2.83 if the measurements are taken in meters) and the quotient shall be deemed to be the tonnage of the space, and shall be added to the tonnage of the ship ascertained as aforesaid; and if the ship has more than three decks, the tonnage of each space between decks above the tonnage deck shall be severally ascertained in the manner above described, and shall be added to the tonnage of the ship ascertained as aforesaid.

SEC. 5. If there be a break, a poop, or any other permanently covered or closed-in space on or above the upper deck (as defined above in Article III) the tonnage of such space shall be ascertained as follows: Measure the internal mean length of the space in feet, and divide it into two equal parts; measure at the middle of its height three inside breadths, namely, one at each end and the other at the middle of the length; then to the sum of the end breadths add four times the middle breadth, and multiply the whole sum by one-third of the common interval between the breadths; the product will give the mean horizontal area of the space; then measure the mean height and multiply by it the mean horizontal area; divide the product by 100 (or by 2.83 if the measurements are taken in meters) and the quotient shall be deemed to be the tonnage of the space.

SEC. 6. In measuring the length, breadth, and height of the general volume of the ship or that of the other spaces, reduce to the mean thickness the parts of the ceiling which exceed the mean thickness. When the ceiling is absent, or when it is not permanently fixed, the length and breadth shall be reckoned from the main frames of the ship, not from the web or belt frames. The same principle is to hold in the case of deck erections, that is, the breadth is to be reckoned from the main framing or stiffeners of the same, when ceiling is not fitted. When the main framing of the ship is curved or carried upward and inboard so as to permit the building of topside tanks or compartments outboard of the main framing, the breadth of the ship shall be reckoned from the outboard framing of such outboard tanks, thus including these tanks in the measurement.

RULE II.—*For measuring the gross tonnage of laden ships.*

Rule for the measurement of laden vessels.

SEC. 7. When ships have cargo on board, or when for any other reason their tonnage can not be ascertained by means of Rule I, proceed in the following manner:

Measure the length on the uppermost full-length deck from the outside of the outer plank at the stem to the aft side of the sternpost, deducting therefrom the distance between the aft side of the sternpost and the rabbet of the sternpost at the point where the counterplank crosses it. Measure also the greatest breadth of the ship to the outside of the outer planking or wales at the middle perpendicular. Then, having first marked on the outside of the ship on both sides thereof the height of the uppermost full-length deck at the ship's sides, girt the ship at the middle perpendicular in a direction perpendicular to the keel from the height so marked on the outside of the ship, on the one side, to the height so marked on the other side, by passing a chain under

the keel; to half the girth thus taken add half the main breadth; square the sum, multiply the result by the length of the ship taken as aforesaid, then multiply this product by the factor 0.17 in the case of ships built of wood, and by the factor 0.18 in the case of ships built of iron or steel. The product will give approximately the cubical contents of the ship, and the tonnage can be ascertained by dividing by 100 or by 2.83, according as the measurements are taken in English feet or in meters.

SEC. 8. If there be a break, a poop, or other permanently covered and closed-in spaces (as defined above in Article III) on or above the uppermost full-length deck, the tonnage of such spaces shall be ascertained by multiplying together the mean inside length, breadth, and depth of such spaces and dividing the product by 100, or 2.83, according as the measurements are taken in English feet or meters, and the quotient so obtained shall be deemed to be the tonnage of the spaces, and shall be added to the other tonnage in order to determine the gross tonnage or total capacity of the ship.

RULE III.—*For measurement of open vessels.*

Rule for the measurement of open vessels.

SEC. 9. In ascertaining the tonnage of open ships, the upper edge of the upper strake of the shell plating is to form the boundary line of measurement, and the depths shall be taken from an athwartship line, extended from upper edge to upper edge of the said strake at each division of the length.

DEDUCTIONS FROM THE GROSS TONNAGE TO ASCERTAIN THE NET TONNAGE.

(A) DEDUCTIONS FOR VESSELS NOT PROPELLED BY ENGINES.

ART. X. The following spaces (enumerated below in secs. 1 to 10 of this article) shall be deducted from the gross tonnage in order to ascertain the net tonnage of *vessels not propelled by engines,* and no other spaces shall be deducted. Unless otherwise expressly stipulated, these spaces shall be deducted whether located above or below the upper deck.

The volume or cubical contents of deducted spaces shall be ascertained in the manner specified in Article VIII or Article IX of these rules. The remainder, resulting from deducting from the total space included in gross tonnage the sum of the cubical contents of the spaces whose deduction from gross tonnage is permitted by these rules, shall be the net or register tonnage of vessels not propelled by engines and unrigged craft upon which tolls and other charges based upon tonnage shall be paid by vessels of commerce, Army and Navy transports, colliers, supply ships, and hospital ships (as defined in Art. I) for passage through the Panama Canal. One hundred cubic feet, or 2.83 cubic meters, shall constitute one gross or net ton.

Spaces for the use, or possible use, of passengers (as defined in Art. VI) shall not be deducted from the gross tonnage, except in so far as their deduction may be specifically provided for in the following sections (1 to 10) of this article of these rules.

Definition of stores and cargo carried on Army and Navy transports, colliers, supply ships, and hospital ships.

Spaces available for the stowage of stores (other than boatswain's stores) or cargo shall not be deducted from gross tonnage. In case of Army and Navy transports, colliers, supply ships, and hospital ships, as defined in Article I, the term "stores (other than boatswain's stores) or cargo" shall include, in addition to goods or cargo ordinarily carried as freight on vessels of commerce, the following articles:

On transports, food, stores, luggage, accouterments, and equipment for passengers.

On colliers, coal, coaling gear, and fuel oil not for the use of the colliers.

On supply ships, stores, supplies of all kinds, distilling machinery and distilled water (other than feed water stored in double-bottom compartments), machines, tools and material for repair work, mines and mining material, torpedoes, arms, and ammunition.

On hospital ships, food stores for pasengers, medical stores, and hospital equipment.

Guns mounted on transports and supply ships, for defense of the ships, and ammunition required for use in such guns shall not be classed as cargo.

Deductions from gross tonnage allowed vessels not propelled by engines.

SECTION 1. The tonnage of the spaces or compartments occupied by, or appropriated to the use of, the officers and crew of the vessel shall be deducted. The term "officers and crew" shall include the personnel inscribed on the ship's rolls, i. e., the ship's officers, engineers, doctors, apothecary, sick attendants, sailors, apprentices, firemen, mechanics, and wireless operators; but shall not include clerks, pursers, stewards, and other members of the personnel provided by the ship for the care of the passengers. The spaces or compartments occupied by the officers and crew shall include their berthing accommodations, spaces provided for medical attention, mess rooms, ward and dressing rooms, bath and wash rooms, water-closets, latrines, lavatories, or privies for their exclusive use, and passageways exclusively serving these spaces.

SEC. 2. On hospital ships the spaces or compartments occupied by doctors, apothecary, and sick attendants duly inscribed on the ship's rolls, shall form part of the deduction under section 1 of this article. Spaces provided for the medical attention of the officers and crew of a hospital ship shall likewise be deducted; but spaces fitted for the transportation, or for the medical attention, of other persons than those duly listed in the ship's rolls shall not be deducted.

SEC. 3. The space occupied by the master's cabin shall be deducted.

SEC. 4. Cook houses, galleys, bakeries, laundries, and rooms for ice machines, when used exclusively to serve the officers and crew, and the condenser space, and distilling rooms, when used exclusively for condensing and distilling the water for the officers and crew, shall be deducted.

SEC. 5. Spaces used for the anchor gear, steering gear, and capstan; the wheel house, the dynamo rooms; the chart room used exclusively for keeping charts, signals, and other instruments of navigation; lookout houses; spaces for keeping electric searchlights and wireless telegraph appliances; and other spaces actually used in the navigation of the ship, shall be deducted. Such spaces upon vessels of commerce as may be devoted to the mounting of guns and to the stowage of ammunition for the guns thus mounted shall be deducted. The deduction of all spaces, other than those devoted to the mounting of guns, enumerated in this section must be reasonable in extent and be subject to the limitations stipulated below in Article XI.

SEC. 6. In case of a ship propelled wholly by sails, any space, not exceeding 2½ per cent of the gross tonnage, used exclusively for storage of sails shall be deducted.

SEC. 7. Spaces used exclusively for boatswain's stores shall be deducted. The deduction is not, however, to exceed 1 per cent of the gross tonnage in ships of 1,000 tons gross and upwards, nor more than 75 tons in any ship however large. In vessels from 500 to 1,000 tons gross the limit is fixed at 10 tons and in vessels from 150 to 500 tons at not more than 2 per cent of the gross tonnage. In vessels under 150 tons at not more than 3 tons.

SEC. 8. The space occupied by donkey engine and boiler shall be deducted if the donkey engine and boiler are connected with the main pumps of the ship, or if they are located in a permanently covered or closed-in structure on or above the upper deck.

SEC. 9. Passages and passageways shall be deducted if they serve deducted spaces exclusively for the officers and crew.

SEC. 10. Water-ballast spaces, other than spaces in the vessel's double bottom, shall be deducted if they are adapted only for water ballast, have only ordinary manholes for access and are not available for the carriage of cargo, stores, or fuel. If used to carry oil or other fuel, these spaces shall be regarded as part of the vessel's fuel space and shall not be subject to separate deduction.

The marking and use of exempted spaces shall be according to national laws.

ART. XI. Each of the spaces enumerated in Article X, sections 1 to 10, unless otherwise specifically stated, shall be subject to such conditions and requirements as to marking or designation and use or purpose as are contained in the navigation or registry laws of the several countries, but no space, other than fuel spaces deducted under Article XIII of these rules, shall be deducted unless the use to which it is to be exclusively devoted has been appropriately designated by official marking. In no case, however, shall an arbitrary maximum limit be fixed to the aggregate deduction made under Article X.

(B) DEDUCTIONS FOR VESSELS PROPELLED BY ENGINES.

ART. XII. The net or register tonnage upon which tolls and other charges based upon tonnage shall be paid by *vessels* of commerce, Army and Navy transports, colliers, supply ships, and hospital ships, as defined in Article I, *propelled by engines*, for passage through the Panama Canal, shall be the tonnage remaining after the following deductions have been made from the gross tonnage. One hundred cubic feet, or 2.83 cubic meters, shall constitute 1 gross or net ton. Vessels propelled partly by sails and partly by engines shall be classed as "vessels propelled by engines:"

Deductions from gross tonnage allowed vessels propelled by engines.

SECTION 1. The spaces specified above in Article X shall be deducted from the space included in gross tonnage to ascertain net tonnage in the case of vessels propelled by engines as in the case of vessels not propelled by engines.

SEC. 2. The space occupied by the engines, boilers, coal bunkers, fuel-oil tanks, double-bottom fuel and feed-water compartments, shaft trunks of vessels with screw propellers, spaces, within a closed-in side-to-side erection, that are framed in around the funnels or that are required for the introduction of light and air to the engine room to the extent that the framed-in spaces around the funnels and the light and air casings are located below the deck or covering of the first or lowest tier of such erections, if any, on the upper deck, as defined in Article IV, section 3, and are contained in closed-in side-to-side erections, spaces necessary for the proper working of the engines, and spaces occupied by the donkey engine and boiler when situated within the boundary of the engine room or within the light and air casings above the engine room and when used in connection with the main machinery for propelling the vessel. When the shafts of screw propellers pass through open spaces not inclosed within tunnels, the spaces allowed in lieu of the tunnels must be of reasonable dimensions suitable for the vessel in question. When any portion of the engine or boiler rooms is occupied by a tank for fresh water, the space thus taken up shall not be deducted.

Donkey-engine and boiler spaces, when deducted according to Article XIV below, shall not be made a separate deduction.

The portion of the framed-in spaces around the funnels and of the light and air casings that extend above the deck or covering of the first or lowest tier of side-to-side erections, if any, on the upper deck, as defined in Article IV, section 3, and surrounding the said space or spaces are exempted from measurement and form no part of the space deducted under this section.

SEC. 3. The deductions made for propelling power, including all those provided for in section 2 of this article, shall in no case exceed 50 per cent of the gross tonnage, except in case of tugs employed exclusively as tugs. In

other respects the spaces enumerated in section 2 shall, except as otherwise specifically stated, be subject to the requirements as to designation or marking and use or purpose contained in the navigation or registry laws of the several countries.

SEC. 4. The deductions made for propelling power provided for in section 2 of this article shall be made according to the provisions of Article XIII or of Article XIV, *as the owner of the vessel may elect.*

SEC. 5. Double-bottom compartments that are set aside to be used exclusively for the stowage of feed water for the ship's boilers shall be deducted.

Propelling power deduction for vessels with bunkers having movable partitions, or having fuel-oil compartments that may be used to stow cargo or stores.

ART. XIII. In ships that do not have fixed bunkers, but transverse bunkers with movable partitions, with or without lateral bunkers, and in ships with fuel tanks or double-bottom fuel compartments which may be used to stow cargo or stores, measure the space occupied by the engine rooms, and add to it for vessels with screw propellers 75 per cent and for vessels with paddle wheels 50 per cent of such space.

By the space occupied by the engine rooms is to be understood that occupied by the engine room itself and the boiler room, together with the spaces strictly required for the working of the engines and boilers, with the addition of the spaces taken up by shaft trunks (in vessels with screw propellers), the spaces which inclose the funnels and the casings necessary for the admission of light and air into the engine room to the extent that such spaces are located below the upper deck or below a deck with openings (usually designated as tonnage openings) which may be so closed as to permit the carriage of cargo or stores under the deck or a portion thereof, and donkey-engine and boiler spaces when the donkey engine and boiler are situated within the boundary of the main engine room or of the light and air casing above it and when they are used in connection with the main machinery for propelling the vessel. When the shafts of screw propellers pass through open spaces not inclosed within tunnels, the spaces allowed in lieu of tunnels must be of reasonable dimensions suitable for the vessel in question. When a portion of the space within the boundary of the engine or boiler rooms is occupied by a tank or tanks for fuel oil or fresh water, the space considered to be within the engine room shall be reduced by the space taken up by the tank or tanks for fuel oil or fresh water.

The cubical contents of the above-named spaces occupied by the engine room shall be ascertained in the following manner: Measure the mean depth of the space occupied by the engines and boilers from its crown to the ceiling at the limber strake; measure also three, or, if necessary, more than three, breadths of the space at the middle of its depth, taking one of such measurements at each end and another at the middle of the length; take the mean of such breadths; measure also the mean length of the space between the foremost and aftermost bulkheads or limits of its length, excluding such parts, if any, as are not actually occupied by or required for the proper working of the engines and boilers. Multiply together these three dimensions of length, breadth, and depth, and the product will be the cubical contents of the space below the crown. Then, by multiplying together the length, breadth, and depth, find the cubical contents of the space or spaces, if any, which are framed in for the machinery, for inclosing the funnels, or for the admission of light and air, and which are located between the crown of the engine room and the uppermost deck or covering of the first or lowest tier of side-to-side erections, if any, on the upper deck, as defined in Art. IV, section 3. Add such contents, as well as those of the space occupied by the shaft trunk and by any donkey engine and boiler located within the boundary of the engine room or of the light and air casing above the engine room and used in connection with the main

engines for propelling the ship, to the eubical contents of the spaee below the erown of the engine room; divide the sum by 100 or by 2.83, aceording as the measurements are taken in feet or meters, and the result shall be deemed to be the tonnage of the engine and boiler room and shall be the tonnage taken as the basis for ealculating the deduetion for propelling power.

If in any ship in which the spaee for propelling power is to be measured the engines and boilers are in separate eompartments, the eontents of each eompartment shall be measured separately in like manner, aeeording to the above method; and the sum of the tonnage of the spaees ineluded in the several compartments shall be deemed to be the tonnage of the engine and boiler rooms, and shall be the tonnage taken as the basis for ealeulating the deduction for propelling power.

Propelling power deduction for vessels with fixed bunkers, or having fuel-oil compartments that can not be used to stow cargo or stores.

ART. XIV. When vessels are fitted with fixed eoal bunkers or with fuel-oil tanks or double-bottom fuel eompartments which ean not be used to stow eargo or stores, and when sueh bunkers, tanks, and fuel eompartments have been certified by offieial marking to be spaces for the vessel's fuel, the deduetion for propelling power may either be in aceordance with the provisions of Artiele XIII above, or by deducting the actual tonnage of the spaees enumerated in Art. XII, See. 2 as measured in aceordanee with the following provisions, as the owner of the vessel may elect: Measure the mean length of the engine and boiler room, ineluding the eoal bunkers. Ascertain the area of three transverse seetions of the ship (as set forth in the rules given in Artieles VIII or IX for the ealeulation of the gross tonnage) to the deck whieh covers the engine. One of these three seetions must pass through the middle of the aforesaid length, and the two others through the two extremities. Add to the sum of the two extreme sections four times the middle one, and multiply the sum thus obtained by the third of the distanee between the seetions. This produet divided by 100 if the measurements are taken in English feet, or by 2.83 if they are taken in meters, gives the tonnage of the spaee measured. If the engines, boilers, and bunkers are in separate eompartments, measure eaeh compartment, as above set forth, and add together the results of the several measurements. The bunkers measured for fuel deduetion shall include only those bunkers that are absolutely permanent, from which the coal can be trimmed directly into the engine room or stokehole, and into whieh aecess can be obtained only through the ordinary eoal chutes on deek and from doors opening into the engine room or stokehole. Thwartship bunkers that can be in any way extended are not to be included in the measurements for deductions. When any portion of the engine or boiler rooms is oceupied by a tank for fresh water, the spaee eonsidered to be within the engine and boiler rooms shall be redueed by the space taken up by the tank for fresh water.

The eontents of the shaft trunk shall be measured by ascertaining, and multiplying together, the mean length, breadth, and height. The product divided by 100, or 2.83, aeeording as the measurements are taken in English feet or in meters, gives the tonnage of sueh spaee. When the shafts of serew propellers pass through open spaees not inelosed within tunnels, the spaees allowed in lieu of tunnels must be of reasonable dimensions suitable for the vessel in question.

The tonnage of the following spaees below the deek or eovering of the first or lowest tier of side-to-side ereetions, if any, on the upper deck, as defined by Art. IV, seetion 3, is aseertained by the same method, viz: (*a*) The spaees framed in around the funnels. (*b*) The spaces required for the admission of light and air into the engine room. (*c*) The spaees, if any, necessary for the proper working of the engines. (*d*) Spaees oeeupied by the donkey engine and

boiler when used in connection with the main engines for propelling the ship and when situated within the boundary of the engine room or of the casing above the engine room. (*e*) Fuel-oil tanks and double-bottom compartments fitted for the stowage of fuel oil.

No space may be deducted unless included in gross tonnage.

ART. XV. Under no circumstances shall any space which has not been included in the gross tonnage be deducted from gross tonnage.

Deducted spaces, if used, must be added to net tonnage.

The use of the whole or any portion of a deducted space, other than fuel spaces deducted under Article XIII, to stow cargo of any kind or stores other than boatswain's stores, or to provide passenger accommodations, shall be evidence that the entire space thus wholly or partially occupied is a part of the actual earning capacity of the ship, and the entire space shall be added to, and become a permanent part of, the net tonnage upon which Panama Canal tolls shall be collected.

Officials that may measure vessels and issue certificates.

ART. XVI. Only such officials as are authorized in the several foreign countries and in the United States to measure vessels and to issue tonnage certificates for purposes of national registry, and such other officials as are authorized by the President of the United States, or by those acting for him, to measure vessels and to issue Panama Canal tonnage certificates, shall have authority to measure vessels for Panama navigation or to issue Panama tonnage certificates.

Tonnage certificates issued under these rules may be corrected by officials at the Panama Canal.

ART. XVII. Tonnage certificates presented at the Panama Canal shall be subject to correction by the official or officials authorized by the President of the United States, or by those acting for him, to administer these measurement rules, in so far as may be necessary to make the certificates conform to these rules.

Panama Canal tonnage certificates.

ART. XVIII. The Panama Canal tonnage certificates issued by the measurement authorities of the United States and the several foreign countries shall correspond in substance and form to the sample certificate appended to these rules. Blank certificates in English will be furnished by the Secretary of War or the Governor of the Panama Canal upon request of the measurement authorities of foreign countries. The measurement authorities of any foreign country may also provide themselves with Panama Canal measurement certificates printed in English or in the language of the foreign country, provided such certificates strictly correspond in substance and form to the sample certificate appended to these rules.

RULES APPLYING TO VESSELS OF WAR, OTHER THAN ARMY AND NAVY TRANSPORTS, COLLIERS, SUPPLY SHIPS, AND HOSPITAL SHIPS.

Tolls upon warships shall be levied upon actual displacement upon arrival at canal.

ART. XIX. The toll on warships, other than Army and Navy transports, colliers, supply ships, and hospital ships, shall be based upon their tonnage of actual displacement at the time of their application for passage through the canal. The displacement tonnage of such warships shall be their displacement before the vessels have taken on such coal, fuel oil, stores, or supplies as may be purchased and taken on board after arrival at the canal for transit through the same.

"Warships" defined.

ART. XX. "Warships" in the meaning of Articles XIX to XXIV shall be considered to be all vessels of war, other than Army and Navy transports, colliers, hospital ships, and supply ships, as defined in Article I. Warships are vessels of Government ownership that are being employed by their owners for military or naval purposes.

For determination of draft, warships to anchor at station designated by governor of Panama Canal.

ART. XXI. Every warship, other than Army and Navy transports, colliers, supply ships, and hospital ships (as defined in Art. I) upon applying for passage through the Panama Canal shall, in order to facilitate the ascertainment of its mean draft, be anchored or placed at such station or location as shall be designated by the Governor of the Panama Canal or by the officials authorized to act for him.

Commander of each warship to exhibit vessel's displacement scale and curves.

ART. XXII. The commander of every warship, other than Army and Navy transports, colliers, supply ships, and hospital ships (as defined in Art. I), applying for passage through the Panama Canal shall exhibit for examination by the Governor of the Panama Canal or by the officials authorized to act for the Governor of the Panama Canal an official document containing the vessel's curve of displacement, its curves for addition to displacement for change of trim, and a scale so arranged that the displacement at any given mean draft is shown. Such document or documents shall be issued and be certified as correct by competent authorities of the Government to which the vessel belongs.

Actual displacement to be determined, and to be expressed in tons of 2,240 pounds.

ART. XXIII. The actual displacement of warships shall be determined from their official displacement scale and curves, and shall be expressed in tons of 2,240 pounds. Should the displacement scale and curves of a warship show or state the vessel's displacement tonnage in metric tons of 2,204.62 pounds, the tonnage so expressed shall be multiplied by 0.9842 for the purpose of converting the tonnage into tons of 2,240 pounds.

Rule for determining displacement of a warship not supplied with displacement scale and curves.

ART. XXIV. Should any warship, other than Army and Navy transports, colliers, supply ships, and hospital ships (as defined in Article I) apply for passage through the Panama Canal and, for reasons satisfactory to the Governor of the Panama Canal, not have on board the duly certified document or documents specified in Article XXII, the Governor of the Panama Canal, or the officials authorized to act for him, shall then determine the displacement of the vessel, using such reliable data as may be available, or by taking such dimensions of the vessel and using such approximate methods as may be considered necessary and practicable. The displacement tonnage so determined shall be considered to be the displacement of the vessel.

5. Exemptions under Article IV, Sec. 3.—

Spaces framed in round funnels

Spaces framed in round light an

6. Exemptions under Article IV, Sec. 4.—

7. Exemptions under Article IV, Sec. 6.—

8. Exemptions under Article IV, Sec. 7.—

9. Particulars as to hatchways (Article IV,

10. State any other particulars of exempte

THIS IS TO CERTIFY that

Vessels for the Panama Canal, and that th

Given under my hand at ...

PANAMA CANAL

TONNAGE CERTIFICATE

FOR THE

Ship

61803°—13. (To face page 242.)

Name of Ship.	Official Number or Signal.	Port of Registry.	Tonnage on Certificate of National Registry.		Register Length.	Register Breadth.	Register Depth.
			Gross.	Net.			

DETAILS OF PANAMA CANAL GROSS TONNAGE.

The spaces measured for gross tonnage in this ship comprise the following and no others, viz:

	Tons of 100 cubic feet.	Cubic feet or cubic meters.	Tons of 100 cubic feet.
1. Space or spaces under the tonnage deck, viz:			
(a) Space between tonnage deck and double bottom			
(b) Double-bottom compartments available for fuel, cargo, feed-water, or stores			
Total space under tonnage deck			
2. Space or spaces between the tonnage deck and uppermost full length deck			
	Tons of 100 cubic feet.		
3. Closed-in spaces under or in permanent constructions on or above the uppermost full length deck, viz:			
(a) Forecastle			
(b) Bridge space			
(c) Poop			
(d) Break or breaks			
(e) Turret space			
(f) Trunk space			
(g) Round houses ..... tons, ... tons, ... tons, ... tons, ... tons, ... tons			
" " ..... tons, ... tons, ... tons, ... tons, ... tons, ... tons			
(h) Side houses ..... tons, ... tons, ... tons, ... tons, ... tons, ... tons			
" " ..... tons, ... tons, ... tons, ... tons, ... tons, ... tons			
(i) Companion house or companionway (dimensions and tonnage of part used as smoking room or for other special purposes)			
(j) Passageways serving measured spaces			
(k) Cookhouses, galleys, bakeries, and condenser spaces			
(l) Lavatories, water-closets, latrines, privies, toilets, wash and bath rooms			
(m) Wheelhouses, chart house, house for donkey engine and boiler, spaces for anchor gear, steering gear and capstan, lookout houses, and other closed-in spaces used in working the ship			
(n) Sail room			
(o) Boatswain's stores			
(p) Hatchways ..... tons, ... tons, ... tons, ... tons, ... tons, ... tons			
" ..... tons, ... tons, ... tons, ... tons, ... tons, ... tons			
Excess above one-half per cent of the gross tonnage as figured above			
Total closed-in spaces on or above the uppermost full length deck			
PANAMA CANAL GROSS TONNAGE*			

* For spaces not included in Gross and Net Tonnage, see page 4 of this Certificate.

DEDUCTIONS FROM GROSS TONNAGE.*

	Tons of 100 cubic feet.	Cubic feet or cubic meters.	Tons of 100 cubic feet.
1. Crew accommodations, viz:			
(a) Berthing accommodations and passageways serving them (name them):—Seamen . . .. tons, firemen .... tons,			
quartermasters .... tons, ... tons, ... tons, ... tons.			
(b) Mess rooms, ward and dressing rooms, bath and wash rooms, medical attention rooms, etc., if separate from berthing accommodations			
2. Officers' accommodations and passageways serving them. (State dimensions and tonnage.)			
(a) Berthing accommodations: (Name them): Chief officer .... tons,			
2d officer . ... tons, ... tons,			
chief engineer . ... tons, 2d engineer . .. . tons,			
3d engineer ... ... tons, ... tons,			
boatswam .... tons, carpenter..... ... . tons,			
... ... tons, ... tons.			
(b) Mess rooms: Officers... . tons, ... tons,			
Engineers .... tons, petty officers .. .. tons.			
(c) Bath and wash rooms: Officers . . . tons, ... tons,			
Engineers .... tons, petty officers .... tons.			
(d) Doctor's cabin.			
(e) Master's cabin.			
3. Cookhouses, galleys, bakeries, and condenser spaces for exclusive use of officers, engineers, and crew (state dimensions and tonnage):			
... .			
....			
4. Lavatories, water-closets, latrines, privies, and toilets, for exclusive use of officers, engineers, and crew, and passageways serving them (state dimensions and tonnage) viz:			
Crew .... tons, ... tons,			
" ... . tons, ... tons,			
.... tons, ... tons,			
5. Closed-in spaces used in working the ship, and passageways serving them (state dimensions and tonnage) viz:			
Chart house . .. . tons. Lookout house .... tons			
Signal house .. .. tons. Wheelhouse .... tons			
Space for steering gear .. . . tons, space for capstan ..... tons, donkey engine and boiler room, ...			
as under Article X, Sec. 8 † .... tons, ... tons. ... . tons			
.... tons, ... tons, ... tons			
6. Sailroom as limited in Article X, Sec. 6 (dimensions and tonnage)			
7. Boatswain's store-rooms (dimensions and tonnage)			
8. Water-ballast spaces other than double-bottom compartments, under conditions provided in Article X, Sec. 10.			
9. Double-bottom feed-water compartments as under Article XII, Sec. 5			
Total deduction, other than for propelling power			
PANAMA CANAL NET TONNAGE (without deduction for propelling power)			

FURTHER DEDUCTIONS FOR PROPELLING POWER IN CASE OF VESSELS PROPELLED BY ENGINES:

	Tons of 100 cubic feet
Either (1) applicable to ships with fixed bunkers or with fuel-oil tanks or double-bottom compartments which can not be used to stow cargo or stores:	
(a) Engine room as measured (as defined in Article XIV) { Tonnage below deck . . .. / Tonnage between decks	
(b) Fixed coal bunkers or fuel-oil tanks and double-bottom compartments fitted for stowage of fuel oil.	
Total deduction for propelling power	
PANAMA CANAL NET TONNAGE, POWER DEDUCTION BY ACTUAL MEASUREMENT (Arts. XII and XIV) (Limited except for tugs to 50 per cent of gross tonnage)	

	Tons of 100 cubic feet
Or (2) Danube rule as defined in Articles XII and XIII:	
(a) Engine room as measured (as defined in Article XIII) { Tonnage below deck .... / Tonnage between decks	
(b) In a vessel with screw propellers + 75 per cent of engine room as measured.....	
(c) In a vessel with paddle wheels + 50 per cent of engine room as measured.-	
Total deduction for propelling power. (Limited except for tugs to 50 per cent of gross tonnage)	
PANAMA CANAL NET TONNAGE, POWER DEDUCTION BY DANUBE RULE (Arts. XII and XIII)	

* No space, other than fuel spaces deducted under Article XIII of the Panama Measurement Rules, shall be deducted unless the use to which it is to be exclusively devoted has been appropriately designated by official marking.
† References to articles and sections are to the "Rules for the Measurement of Vessels for the Panama Canal."

SPACES NOT INCLUDED IN GROSS TONNAGE.

INFORMATION MUST BE GIVEN CONCERNING ALL SPACES EXEMPTED FROM MEASUREMENT.

1. Exemptions under Article IV, Sec. 1 (a)—(Name or otherwise identify) .....

2. Exemptions under Article IV, Sec. 1 (b)—(Name and state separately the dimensions and tonnage of the parts exempted):

   Poop .....

   Forecastle .....

   Bridge .....

3. Exemptions under Article IV, Sec. 1 (c) (Name and state separately the dimensions and tonnage of the parts exempted):

   Poop .....

   Forecastle .....

   Bridge .....

4. Exemptions under Article IV, Sec. 2.—(Name the deck and state separately the dimensions and tonnage of the parts exempted).

5. Exemptions under Article IV, Sec. 3.—(Name spaces exempted):

   Spaces framed in round funnels .....

   Spaces framed in round light and air casings .....

6. Exemptions under Article IV, Sec. 4.—(Name or give number of double-bottom compartments exempted):

7. Exemptions under Article IV, Sec. 6.—(Name or otherwise identify spaces exempted):

8. Exemptions under Article IV, Sec. 7.—(Name or otherwise identify spaces exempted):

9. Particulars as to hatchways (Article IV, Sec. 5) need not be restated if fully given on second page of this certificate.

10. State any other particulars of exempted spaces:

THIS IS TO CERTIFY that the ..... (Nationality) ..... ship above named has been measured in accordance with the Rules for the Measurement of Vessels for the Panama Canal, and that the particulars of tonnage contained in this Certificate are correct.

Given under my hand at ....., this ....., 19..

.....(Signature.)

.....(Official position.)

-(Name spaces exempted) :

---

d air casings ---

-(Name or give number of double-bottom compartments exempted):

-(Name or otherwise identify spaces exempted) :

-(Name or otherwise identify spaces exempted) :

Sec. 5) need not be restated if fully given on second page of this certificate.

---

l spaces :

the ---(Nationality)--- ship above named has been measured in accordance with the Rules for the Measurement of

e particulars of tonnage contained in this Certificate are correct.

---, this ---, 191

--- (Signature.)

--- (Official position.)

APPENDICES.

DOCUMENTS UPON THE MEASUREMENT OF VESSELS AND THE OPERATION OF CANALS.

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APPENDIX I.

AMERICAN LAWS CONCERNING THE MEASUREMENT OF VESSELS.

[SECTIONS 13 TO 27 OF "NAVIGATION LAWS OF THE UNITED STATES." EDITION OF 1911.]

APPENDIX I.

NAVIGATION LAWS OF THE UNITED STATES.

Part II.—Measurement.

13. *Measurement.*—Before any vessel shall be registered she shall be measured by a surveyor, if there be one, or by the person he shall appoint, at the port or place where the vessel may be, and if there be none, by such person as the collector of the district within which she may be shall appoint. But in all cases where a vessel has before been registered as a vessel of the United States, it shall not be necessary to measure her anew, for the purpose of obtaining another register, unless such vessel has undergone some alteration as to her burden, subsequent to the time of her former registry.—(R. S., 4148.)

The officer or person by whom such measurement is made shall, for the information of and as a voucher to the officer by whom the registry is to be made, grant a certificate, specifying the build of the vessel, her number of decks and masts, her length, breadth, depth, the number of tons she measures, and such other particulars as are usually descriptive of the identity of a vessel, and that her name, and the place to which she belongs, are painted on her stern in manner required by this title [R. S., 4131–4305]; which certificate shall be countersigned by an owner, or by the master of such vessel, or by some other person who shall attend her admeasurement, on behalf of her owner or owners, in testimony of the truth of the particulars therein contained; without which the certificate shall not be valid.—(R. S., 4149.)

The registry of every vessel shall express her length and breadth, together with her depth and the height under the third or spar deck, which shall be ascertained in the following manner: The tonnage deck, in vessels having three or more decks to the hull, shall be the second deck from below; in all other cases the upper deck of the hull is to be the tonnage deck. The length from the fore part of the outer planking on the side of the stem to the after part of the main sternpost of screw steamers, and to the after part of the rudderpost of all other vessels measured on the top of the tonnage deck, shall be accounted the vessel's length. The breadth of the broadest part on the outside of the vessel shall be accounted the vessel's breadth of beam. A measure from the underside of the tonnage-deck plank, amidships, to the ceiling of the hold (average thickness) shall be accounted the depth of hold. If the vessel has a third deck, then the height from the top of the tonnage-deck plank to the underside of the upper-deck plank shall be accounted as the height under the spar deck. All measurement to be taken in feet and fractions of feet, and all fractions of feet shall be expressed in decimals.—(R. S., 4150.)

No part of any vessel shall be required by the preceding section to be measured or registered for tonnage that is used for cabins or staterooms, and constructed entirely above the first deck, which is not a deck to the hull.—(R. S., 4151.)

14. *Gross tonnage.*—The register tonnage of every vessel built within the United States or owned by a citizen or citizens thereof shall be her entire internal cubical capacity in tons of 100 cubic feet each, to be ascertained as follows: Measure the length of the vessel in a straight line along the upper side of the tonnage deck, from the inside of the inner plank, average thickness, at the side of the stem to the inside of the plank on the stern timbers, average thickness, deducting from this length what is due to the rake of the bow in the thickness of the deck, and what is due to the rake of the stern timber in the thickness of the deck, and also what is due to the rake of the stern timber in one-third of the round of the beam; divide the length so

taken into the number of equal parts required by the following table, according to the class in such table to which the vessel belongs:

Class 1. Vessels of which the tonnage length according to the above measurement is 50 feet or under—into 6 equal parts.

Class 2. Vessels of which the tonnage length according to the above measurement is above 50 feet and not exceeding 100 feet—into 8 equal parts.

Class 3. Vessels of which the tonnage length according to the above measurement is above 100 feet and not exceeding 150 feet—into 10 equal parts.

Class 4. Vessels of which the tonnage length according to the above measurement is above 150 feet and not exceeding 200 feet—into 12 equal parts.

Class 5. Vessels of which the tonnage length according to the above measurement is above 200 feet and not exceeding 250 feet—into 14 equal parts.

Class 6. Vessels of which the tonnage length according to the above measurement is above 250 feet—into 16 equal parts.

Then, the hold being sufficiently cleared to admit of the required depths and breadths being properly taken, find the transverse area of such vessel at each point of division of the length as follows:

Measure the depth at each point of division from a point at a distance of one-third of the round of the beam below such deck; or, in case of a break, below a line stretched in continuation thereof, to the upper side of the floor timber, at the inside of the limber strake, after deducting the average thickness of the ceiling, which is between the bilge planks and limber strake; then, if the depth at midship division of the length do not exceed 16 feet, divide each depth into 4 equal parts; then measure the inside horizontal breadth, at each of the three points of division, and also at the upper and lower points of the depth, extending each measurement to the average thickness of that part of the ceiling which is between the points of measurement; number these breadths from above, numbering the upper breadth 1, and so on down to the lowest breadth; multiply the second and fourth by 4, and the third by 2; add these products together, and to the sum add the first breadth and the last, or fifth; multiply the quantity thus obtained by one-third of the common interval between the breadths, and the product shall be deemed the transverse area; but if the midship depth exceed 16 feet, divide each depth into 6 equal parts instead of 4, and measure as before directed, the horizontal breadths at the five points of division, and also at the upper and lower points of the depth; number them from above as before; multiply the second, fourth, and sixth by 4, and the third and fifth by 2; add these products together, and to the sum add the first breadth and the last, or seventh; multiply the quantities thus obtained by one-third of the common interval between the breadths, and the product shall be deemed the transverse area.

Having thus ascertained the transverse area at each point of division of the length of the vessel, as required above, proceed to ascertain the register tonnage of the vessel in the following manner:

Number the areas successively 1, 2, 3, etc., number 1 being at the extreme limit of the length at the bow, and the last number at the extreme limit of the length at the stern; then, whether the length be divided according to the table into 6 or 16 parts, as in classes 1 and 6, or any intermediate number, as in classes 2, 3, 4, and 5, multiply the second, and every even-numbered area by 4, and the third, and every odd-numbered area, except the first and last, by 2; add these products together, and to the sum add the first and last if they yield anything; multiply the quantities thus obtained by one-third of the common interval between the areas, and the product will be the cubical contents of the space under the tonnage deck; divide this product by 100 and the quotient, being the tonnage under the tonnage deck, shall be deemed to be the register tonnage of the vessel subject to the additions hereinafter mentioned.—(R. S., 4153.)

15. *Deck houses, breaks, etc.*—If there be a break, a poop, or any other permanent closed-in space on the upper deck, available for cargo, or stores, or for the berthing or accommodation

of passengers or crew, the tonnage of that space shall be ascertained as follows and added to the gross tonnage:

Measure the internal mean length of such space in feet, and divide it into an even number of equal parts of which the distance asunder shall be most nearly equal to those into which the length of the tonnage deck has been divided; measure at the middle of its height the inside breadths, namely, one at each end and at each of the points of division, numbering them successively 1, 2, 3, etc.; then to the sum of the end breadths add four times the sum of the even-numbered breadths and twice the sum of the odd-numbered breadths, except the first and last, and multiply the whole sum by one-third of the common interval between the breadths; the product will give the mean horizontal area of such space; then measure the mean height between the planks of the decks, and multiply by it the mean horizontal area; divide the product by 100 and the quotient shall be deemed to be the tonnage of such space, and shall be added to the tonnage under the tonnage decks, ascertained as aforesaid: *Provided*, That nothing shall be added to the gross tonnage for any sheltered space above the upper deck which is under cover and open to the weather; that is, not inclosed.—(R. S., 4153. Mar. 2, 1895, sec. 1h.)

16. *Hatchways.*—The cubical contents of the hatchways shall be obtained by multiplying the length and breadth together and the product by the mean depth taken from the top of beam to the underside of the hatch. From the aggregate tonnage of the hatchways there shall be deducted one-half of 1 per cent of the gross tonnage, and the remainder only shall be added to the gross tonnage of the ship exclusive of the tonnage of the hatchways. (Feb. 6, 1909.)

17. *Between decks.*—If a vessel has a third deck, or spar deck, the tonnage of the space between it and the tonnage deck shall be ascertained as follows:

Measure in feet the inside length of the space, at the middle of its height, from the plank at the side of the stem to the plank on the timbers at the stern, and divide the length into the same number of equal parts into which the length of the tonnage deck is divided; measure, also at the middle of its height, the inside breadth of the space at each of the points of division, also the breadth of the stem and the breadth at the stern; number them successively 1, 2, 3, etc., commencing at the stem; multiply the second and all other even-numbered breadths by 4, and the third, and all the other odd-numbered breadths, except the first and last, by 2; to the sum of these products add the first and last breadths; multiply the whole sum by one-third of the common interval between the breadths, and the result will give, in superficial feet, the mean horizontal area of such space; measure the mean height between the plank of the two decks, and multiply by it the mean horizontal area and the product will be the cubical contents of the space; divide this product by 100, and the quotient shall be deemed to be the tonnage of such space and shall be added to the other tonnage of the vessel ascertained as above directed. And if the vessel has more than three decks the tonnage of each space between decks above the tonnage deck shall be severally ascertained in the manner above described, and shall be added to the tonnage of the vessel, ascertained as above directed. (R. S. 4153.)

18. *Open vessels.*—In ascertaining the tonnage of open vessels the upper edge of the upper strake is to form the boundary line of measurement, and the depth shall be taken from an athwartship line, extending from the upper edge of such strake at each division of the length. (R. S. 4153.)

19. *Water ballast.*—In the case of a ship constructed with a double bottom for water ballast, if the space between the inner and outer plating thereof is certified by the collector to be not available for the carriage of cargo, stores, or fuel, then the depth of the vessel shall be taken to be the upper side of the inner plating of the double bottom, and that upper side shall for the purposes of measurement be deemed to represent the floor timber. (Mar. 2, 1895.) From the gross tonnage there shall be deducted any other space adapted only for water ballast certified by the collector not to be available for the carriage of cargo, stores, supplies, or fuel. (Feb. 6, 1909, sec. 2.)

20. *Net tonnage.*—From the gross tonnage of every vessel of the United States there shall be deducted (Aug. 5, 1882)—

21. *Crew accommodations.*—(*a*) The tonnage of the spaces or compartments occupied by or appropriated to the use of the crew of the vessel. Every place appropriated to the crew of the vessel shall have a space of not less than 72 cubic feet and not less than 12 superficial feet, measured on the deck or floor of that place, for each seaman or apprentice lodged therein. The provisions of this act requiring a crew space of 72 cubic feet per man shall apply only to vessels the construction of which shall be begun after June 30, 1895. Such place shall be securely constructed, properly lighted, drained and ventilated, properly protected from weather and sea, and as far as practicable properly shut off and protected from the effluvium of cargo or bilge water; and failure to comply with this provision shall subject the owner to a penalty of $500. Every place so occupied shall be kept free from goods or stores of any kind not being the personal property of the crew in use during the voyage; and if any such place is not so kept free the master shall forfeit and pay to each seaman or apprentice lodged in that place the sum of 50 cents a day for each day during which any goods or stores as aforesaid are kept or stored in the place after complaint has been made to him by any 2 or more of the seamen so lodged. No deduction from tonnage as aforesaid shall be made unless there is permanently cut in a beam and over the doorway of every such place the number of men it is allowed to accommodate with these words, "Certified to accommodate ——— seamen." (Mar. 2, 1895.)

Every place appropriated to the crew of a seagoing vessel of the United States, except a fishing vessel, yacht, a pilot boat, and all vessels under 200 tons register, shall have a space of not less than 72 cubic feet and not less than 12 square feet measured on the deck or floor of that place for each seaman or apprentice lodged therein: *Provided,* That any such seagoing sailing vessel built or rebuilt after June 30, 1898, shall have a space of not less than 100 cubic feet and not less than 16 square feet measured on the deck or floor of that space for each seaman or apprentice lodged therein. Such place shall be securely constructed, properly lighted, drained, heated, and ventilated, properly protected from weather and sea, and, as far as practicable, properly shut off and protected from the effluvium of cargo or bilge water.

Fishing vessels, yachts, and pilot boats are hereby exempted from the provisions of section 1 of chapter 173 of the laws of 1895, entitled "An act to amend section 1 of chapter 398 of the laws of 1882, entitled 'An act to provide for deductions from the gross tonnage of vessels of the United States,'" so far as said section prescribes the amount of space which shall be appropriated to the crew and provides that said space shall be kept free from goods or stores not being the personal property of the crew in use during the voyage.

Every steamboat of the United States plying upon the Mississippi River or its tributaries shall furnish an appropriate place for the crew, which shall conform to the requirements of this section so far as they shall be applicable thereto by providing sleeping room in the engine room of the steamboats properly protected from the cold, winds, and rain by means of suitable awnings or screens on either side of the guards or sides and forward, reaching from the boiler deck to the lower or main deck, under the direction and approval of the Supervising Inspector General of Steam Vessels, and shall be properly heated. Any failure to comply with this section shall subject the owner or owners to a penalty of $500. (Mar. 3, 1897, sec. 2.)

22. *Deductions for other purposes.*—(*b*) Any space exclusively for the use of the master certified by the collector to be reasonable in extent and properly constructed and the words "Certified for the accommodation of master" to be permanently cut in a beam and over the door of such space.

(*c*) Any space used exclusively for the working of the helm, the capstan, and the anchor gear, or for keeping the charts, signals, and other instruments of navigation and boatswain's stores, and the words "Certified for steering gear," or "Certified for boatswain's stores," or "Certified chart house," as the case may be, to be permanently cut in the beam and over the doorway of each of such spaces.

(*d*) The space occupied by the donkey engine and boiler, if connected with the main pumps of the ship.

(*e*) In the case of a ship propelled wholly by sails any space, not exceeding 2½ per centum of the gross tonnage, used exclusively for storage of sails: *Provided,* That spaces deducted

shall be certified by the collector to be reasonable in extent and properly and efficiently constructed for the purposes for which they are intended, and the words "Certified for storage of sails" to be cut on the beam and over the doorway of such space. (Mar. 2, 1895.)

23. *Deductions for propelling power.*—(*f*) In the case of a ship propelled by steam or other power requiring engine room, a deduction for the space occupied by the propelling power shall be made as follows:

In ships propelled by paddle wheels in which the tonnage of the space occupied by and necessary for the proper working of the boilers and machinery is above 20 per centum and under 30 per centum of the gross tonnage, the deduction shall be 37 per centum of the gross tonnage; and in ships propelled by screws in which the tonnage of the space is above 13 per centum and under 20 per centum of the gross tonnage, the deduction shall be 32 per centum of the gross tonnage. In the case of screw steamers the contents of the trunk shaft shall be deemed spaces necessary for the proper working of the machinery.

(*g*) In the case of other vessels in which the actual space occupied by the propelling machinery amounts in the case of paddle vessels to 20 per centum or under and in the case of screw vessels to 13 per centum or under of the gross tonnage of the ship, the deduction shall consist in the case of paddle vessels of once and a half the tonnage of the actual machinery space and in the case of screw vessels of once and three-fourths the tonnage of the actual machinery space. But if the actual machinery space is so large as to amount in the case of paddle vessels to 30 per centum or above and in the case of screw vessels to 20 per centum or above of the gross tonnage of the ship the deduction shall consist of 37 per centum of the gross tonnage of the ship in the case of a paddle vessel and 32 per centum of the gross tonnage in the case of a screw vessel; or if the owner prefers there shall be deducted from the gross tonnage of the vessel the tonnage of the space or spaces actually occupied by or required to be inclosed for the proper working of the boilers and machinery, including the trunk shaft or alley in screw steamers, with the addition in the case of vessels propelled with paddle wheels of 50 per centum, and in the case of vessels propelled by screws of 75 per centum of the tonnage of such space.[1]

(*i*) On a request in writing to the Commissioner of Navigation by the owners of a ship the tonnage of such portion of the space or spaces above the crown of the engine room and above the upper deck as is framed in for the machinery or for the admission of light and air and not required to be added to gross tonnage shall, for the purpose of ascertaining the tonnage of the space occupied by the propelling power, be added to the tonnage of the engine space, but it shall then be included in the gross tonnage; such space or spaces must be reasonable in extent, safe, and seaworthy, and can not be used for any purpose other than the machinery or for the admission of light and air to the machinery or boilers of the ship. (March 2, 1895.)

24. *Register tonnage.*—And the proper deduction from the gross tonnage having been made, the remainder shall be deemed the net or register tonnage of such vessels. (Aug. 5, 1882.)

The register of the vessel shall express the number of decks, the tonnage under the tonnage deck, that of the between-decks, above the tonnage deck, also that of the poop or other inclosed spaces above the deck, each separately. (R. S., 4153.)

The register or other official certificate of the tonnage or nationality of a vessel of the United States, in addition to what is now required by law to be expressed therein, shall state separately the deductions made from the gross tonnage, and shall also state the net or register tonnage of the vessel.

But the outstanding registers or enrollments of vessels of the United States shall not be rendered void by the addition of such new statement of her tonnage unless voluntarily surrendered; but the same may be added to the outstanding document or by an appendix thereto, with a certificate of a collector of customs that the original estimate of tonnage is amended. (Aug. 5, 1882.)

In every vessel documented as a vessel of the United States the number denoting her net tonnage shall be deeply carved or otherwise permanently marked on her main beam, and shall be so continued; and if the number at any time cease to be continued such vessel shall

[1] For paragraph (*h*) see article 15 above.

be subject to a fine of $30 on every arrival in a port of the United States if she have not her tonnage number legally carved or permanently marked. (R. S., 4153, June 19, 1886, sec. 5.)

Under the direction of the Secretary of Commerce and Labor the Commissioner of Navigation shall make regulations needful to give effect to the provisions of this act. The Secretary of Commerce and Labor shall establish and promulgate a proper scale of fees to be paid for the readmeasurement of the spaces to be deducted from the gross tonnage of a vessel on the basis of the last sentence of section 4186 of the Revised Statutes, beginning with the words "But the charge for the measurement." (Mar. 2, 1895, sec. 4; Feb. 14, 1903, sec. 10; Aug. 5, 1882, sec. 3.)

25. *Appendix of measurement.*—Upon application by the owner or master of an American vessel in foreign trade, collectors of customs, under regulations to be approved by the Secretary of Commerce and Labor, are authorized to attach to the register of such vessel an appendix stating separately, for use in foreign ports, the measurement of such space or spaces as are permitted to be deducted from gross tonnage by the rules of other nations and are not permitted by the laws of the United States. (Mar. 2, 1895; Feb. 14, 1903, sec. 10.)

This act shall not be construed to require the remeasurement of any American vessel duly measured before April 1, 1895, but upon application by the owner of any such vessel collectors of customs shall cause such vessel, or the spaces to be deducted, to be measured according to the provisions of this act, and if a new register is not issued the statement of such remeasurement shall be attached by an appendix to the outstanding register or enrollment with a certificate of the collector of customs that the original estimate of tonnage is amended pursuant to this act. (Mar. 2, 1895, sec. 2.)

26. *Vessels exempt from measurement.*—The provisions foregoing relating to the measurement of vessels shall not be deemed to apply to any vessel not required by law to be registered or enrolled or licensed, unless otherwise specially provided. (R. S., 4152.)

27. *Measurement of foreign vessels.*—Whenever it is made to appear to the Secretary of Commerce and Labor that the rules concerning the measurement for tonnage of vessels of the United States have been substantially adopted by the Government of any foreign country he may direct that the vessels of such foreign country be deemed to be of the tonnage denoted in their certificates of register or other national papers, and thereupon it shall not be necessary for such vessels to be remeasured at any port in the United States; and when it shall be necessary to ascertain the tonnage of any vessel not a vessel of the United States, the said tonnage shall be ascertained in the manner provided by law for the measurement of vessels of the United States. (R. S., 4154, Aug. 5, 1882, sec. 2; Feb. 14, 1903, sec. 10.)

APPENDIX II.

RULES AND REGULATIONS OF THE UNITED STATES CONCERNING THE MEASUREMENT OF VESSELS.

[ARTICLES 71–87 "CUSTOMS REGULATIONS OF THE UNITED STATES, 1908."]

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RULES AND REGULATIONS OF THE UNITED STATES CONCERNING THE MEASUREMENT OF VESSELS.

ARTICLES 71–87 "CUSTOMS REGULATIONS OF THE UNITED STATES, 1908."

ARTICLE 71. *Method of measurement.*—The document of every vessel shall express her length, breadth, and depth, and the height under the third or spar deck, which shall be ascertained in the following manner: The tonnage deck, in vessels having three or more decks to the hull, shall be the second deck from below; in all other cases the upper deck of the hull is to be the tonnage deck.

The length from the fore part of the outer planking, on the side of the stem, to the after part of the main sternpost of screw steamers, and to the after part of the rudderpost of all other vessels, measured on the top of the tonnage deck, shall be accounted the vessel's length. The breadth of the broadest part on the outside of the vessel shall be accounted the vessel's breadth of beam.

A measure from the underside of tonnage deck plank, amidships, to the ceiling of the hold, average thickness, shall be accounted the depth of hold. If the vessel has a third deck, then the height from the top of the tonnage deck plank to the underside of the upper deck plank shall be accounted as the height under the spar deck. All measurements to be taken in feet and fractions of feet; and all fractions of feet shall be expressed in decimals. (R. S., 4150.)

ART. 72. *Definition of tonnage.*—The legal tonnage of a vessel shall be her entire internal cubical capacity, exclusive of the spaces hereinafter directed to be deducted, expressed in tons of 100 cubic feet each, to be ascertained as follows: Measure the length of the vessel in a straight line along the upper side of the tonnage deck, from the inside of the inner plank, average thickness, at the side of the stem to the inside of the plank on the stern timbers, average thickness, deducting from this length what is due to the rake of the bow in the thickness of the deck and what is due to the rake of the stern timber in the thickness of the deck, and also what is due to the rake of the stern timber in one-third of the round of the beam; divide the length so taken into the number of equal parts required by the following table, according to the class in such table to which the vessel belongs. (R. S., 4153.)

ART. 73. *Tonnage classes.*—The classes shall be arranged as follows:

Class 1. Vessels of which the tonnage length according to the above measurement is 50 feet, or under, into 6 equal parts.

Class 2. Vessels of which the tonnage length according to the above measurement is above 50 feet, and not exceeding 100 feet long, into 8 equal parts.

Class 3. Vessels of which the tonnage length according to the above measurement is above 100 feet long, and not exceeding 150 feet long, into 10 equal parts.

Class 4. Vessels of which the tonnage length according to the above measurement is above 150 feet, and not exceeding 200 feet long, into 12 equal parts.

Class 5. Vessels of which the tonnage length according to the above measurement is above 200 feet, and not exceeding 250 feet long, into 14 equal parts.

Class 6. Vessels of which the tonnage length according to the above measurement is above 250 feet long, into 16 equal parts.

ART. 74. *Transverse areas.*—Then, the hold being sufficiently cleared to admit of the required depths and breadths being properly taken, find the transverse area of such vessel at each point of division of the length as follows:

Measure the depth at each point of division from a point at a distance of one-third of the round of the beam below such deck, or, in case of a break, below a line stretched in continuation thereof, to the upper side of the floor timber, at the inside of the limber strake, after deducting the average thickness of the ceiling, which is between the bilge planks and limber strake; then if the depth of the midship division of the length does not exceed 16 feet, divide each depth into 4 equal parts; then measure the inside horizontal breadth at each of the three points of division, and also at the upper and lower points of the depths, extending each measurement to the average thickness of that part of the ceiling which is between the points of measurement, or, should there be no ceiling between these points, to an allowance of one-tenth of a foot on each side of the vessel in lieu thereof; number these breadths from above, numbering the upper breadth 1, and so on down to the lowest breadth; multiply the second and fourth by 4, and the third by 2; add these products together and to the sum add the first breadth and the last, or fifth; multiply the quantity thus obtained by one-third of the common interval between the breadths, and the product shall be deemed the transverse area; but if the midship depth exceeds 16 feet, divide each depth into 6 equal parts instead of 4, and measure, as before directed, the horizontal breadths at the five points of division and also at the upper and lower points of the depth; number them from above as before; multiply the second, fourth, and sixth by 4, and the third and fifth by 2; add these products together and to the sum add the first breadth and the last, or seventh; multiply the quantities thus obtained by one-third of the common interval between the breadths and the product shall be deemed the transverse area.

ART. 75. *Cubical contents.*—Having thus ascertained the transverse area at each point of division of the length of the vessel, as required above, proceed to ascertain the register tonnage of the vessel in the following manner:

Number the areas, successively, 1, 2, 3, etc., No. 1 being at the extreme limit of the length at the bow and the last number at the extreme limit of the length at the stern; then, whether the length be divided according to table into 6 or 16 parts, as in classes 1 and 6, or any intermediate number, as in classes 2, 3, 4, 5, multiply the second and every even-numbered area by 4, and the third and every odd-numbered area, except the first and last, by 2; add these products together and to the sum add the first and last, if they yield anything; multiply the quantities thus obtained by one-third of the common interval between the areas, and the product will be the cubical contents of the space under the tonnage deck; divide this product by 100, and the quotient, being the tonnage under the tonnage deck, shall be deemed to be the register tonnage of the vessel, subject to the additions hereinafter mentioned.

ART. 76. *Deck houses.*—If there be a break, a poop, or any other permanent closed-in space on the upper decks or on the spar deck available for cargo or stores or for the berthing or accommodation of passengers or crew the tonnage of such space shall be ascertained as follows:

Measure the internal mean length of such space in feet and divide it into an even number of equal parts, of which the distance asunder shall be most nearly equal to those into which the length of the tonnage deck has been divided; measure, at the middle of its height, the inside breadths, namely, one at each end and at each of the points of division, numbering them, successively, 1, 2, 3, etc.; then to the sum of the end breadths add four times the sum of the even-numbered breadths and twice the sum of the odd-numbered breadths, except the first and last, and multiply the whole sum by one-third of the common interval between the breadths; the product will give the mean horizontal area of each space; then measure the mean height between the plank of the decks, and multiply by it the mean horizontal area; divide the product by 100, and the quotient shall be deemed to be the tonnage of such space, and shall be added to the tonnage under the tonnage decks ascertained as aforesaid.

ART. 77. *Between decks.*[1]—If a vessel has a third deck or spar deck the tonnage of the space between it and the tonnage deck shall be ascertained as follows:

[1] The act of Congress of Feb. 6, 1909, contained the following clause relative to hatchways: "The cubical contents of the hatchways shall be obtained by multiplying the length and breadth together and the product by the mean depth taken from the top of beam to the under side of the hatch. From the aggregate tonnage of the hatchways there shall be deducted one-half of one per cent of the gross tonnage and the remainder shall be added to the gross tonnage of the ship exclusive of the tonnage of the hatchways."

Measure, in feet, the inside length of the space, at the middle of its height, from the plank at the side of the stem to the plank on the timbers at the stern and divide the length into the same number of equal parts into which the length of the tonnage deck is divided; measure also at the middle of its height the inside breadth of the space at each of the points of division, also the breadth of the stem and the breadth of the stern; number them, successively, 1, 2, 3, etc., commencing at the stem; multiply the second and all other even-numbered breadths by 4, and the third and all other odd-numbered breadths, except the first and last, by 2; to the sum of these products add the first and last breadths; multiply the whole sum by one-third of the common interval between the breadths and the result will give, in superficial feet, the mean horizontal area of such space; measure the mean height between the plank of the two decks and multiply by it the mean horizontal area and the product will be the cubical contents of the space; divide this product by 100, and the quotient shall be deemed to be the tonnage of such space and shall be added to the other tonnage of the vessel ascertained as aforesaid.

And if the vessel has more than three decks, the tonnage of each space between decks above the tonnage deck shall be severally ascertained in the manner above described, and shall be added to the tonnage of the vessel, ascertained as aforesaid.

ART. 78. *Open vessels—Measuring instruments.*—In ascertaining the tonnage of open vessels, the upper edge of the upper strake is to form the boundary line of measurement, and the depth shall be taken from an athwartship line extending from upper edge of said strake at each division of the length.

The marine document of the vessel shall express the number of decks, the tonnage under the tonnage deck, that of the between decks above the tonnage deck; also that of the inclosed spaces above the tonnage deck, each separately.

The measurements should be made with a waterproof tape, graduated into feet and tenths of a foot, and as nearly inelastic as possible; Chesterman's metallic tape is recommended.

A pair of sliding rods should be provided for taking the depths, with a guide and a clamp, so that they may be secured in a perpendicular position between the keelson and deck.

A 2-foot rule, with a hinge joint, is required for taking the rake of the bow and stern, and for other purposes.

A carpenter's square will be found useful for setting the sliding rod perpendicular to the keelson.

For taking the breadths in the hold which are beyond the reach of the measuring officers 2 rods will be needed, each about 8 feet long, one having a slot or wheel at the top, through which the tape may be passed; and the other a hook, to which the ring at the end of the tape may be attached.

ART. 79. *Register length, breadth, and depth.*—The register length, breadth, and depth are the external dimensions of vessels, and are taken for the purpose of describing them in their marine documents. (See Diagram 1, fig. 2, and Diagram 2, in Appendix.)

The length may be taken at such a parallel distance from the middle line of the ship as may be necessary in order to clear hatchways and other obstacles, and the ends determined by squaring out from the proper points on the middle line.

The register breadth (Diagram 1, fig. 2) is the outside breadth of the vessel at the broadest part, and is to be taken by means of plumb lines let fall so as to touch the sides of the vessel.

The register depth (Diagram 1, fig. 2) is to be taken from the underside of the tonnage deck plank, amidships, to the ceiling in the hold—average thickness—at the side of the keelson, in a direction perpendicular to the keel, by means of a square placed upon the upper side of the keelson.

ART. 80. *Processes of measurement.*—Admeasurers of vessels will not proceed to ascertain tonnage until the vessel is sufficiently cleared to comply with Revised Statutes 4153. The tonnage measurements are taken for the purpose of ascertaining the internal capacity of vessels in tons of 100 cubic feet each.

It may, however, sometimes be impracticable to ascertain either of the terminal points of the tonnage length on the upper side of the deck. In such cases the same result may be more

conveniently reached by taking the length below the tonnage deck, from the inner planking under the deck hook, at the side of the stem, to the inner planking on the stern timbers, under the deck timbers; adding the rake of the bow in the thickness of the deck hook and the rake of the stern in the thickness of the deck timbers. (See Diagram 1, fig. 4.)

The round or spring of the beam is the perpendicular distance from the crown of the underside of the tonnage deck plank, at the center, to a line stretched athwart the vessel from end to end of the top of the beam, and is to be ascertained at every place where it is to be used in the measurement.

If necessary, the round of the beam may also be taken above the deck by stretching a line horizontally across the top of the deck athwartships, touching the deck at the middle; the height of the line above the deck at the side of the vessel will then be the round of the beam. This method is, however, less accurate, and should be used only when the other method is impracticable.

The tonnage length having been thus determined, and the number of sections to be measured and the interval between them ascertained, a line is then to be extended down the main hatchway, at the middle line of the ship, in a direction perpendicular to the keel, by means of a square placed on the upper side of the keelson; the distance of the midship section from this line at the tonnage deck is then to be set off from the line in the same direction on the keelson, which gives the position of the midship section on the keelson; and the positions of the other sections are obtained on the keelson by setting off afore and abaft the midship one the common interval between them as already determined.

The points so fixed should be marked with chalk and numbered consecutively from bow to stern, No. 1 being at the bow. (See Diagram 2.)

ART. 81. *Processes of measurement, continued.*—So much having been accomplished, fix, by means of the clamps, the sliding rod in a direction perpendicular to the keel, at one of the points so numbered, firmly between the underside of the deck and the upper side of the floor timber at the inside of the limber strake, keeping the measuring staff square to the keel in both directions by means of a square placed on the upper side of the keelson; measure the depth from the underside of the tonnage-deck plank to the ceiling in the hold, average thickness, deducting one-third of the round of the beam. Divide the depth into 4 equal parts if the midship depth does not exceed 16 feet, and into 6 equal parts if it exceeds 16 feet. Then mark with white chalk on the rod the divisional points of the depth, No. 1 being at the top of the tonnage depth, i. e., at a distance below the deck plank equal to one-third the round of the beam at that point. At each point so marked measure the breadth from ceiling to ceiling, square athwartships, and at right angles to the rod.

The bottom widths are to be taken only so far as the apparent flat of floor extends. Where there is perceptible rise immediately from the keelson, the bottom widths should be taken equal to the width of the keelson.

This process will be repeated at every section. Care should be taken in all measurements to bring them to the average thickness of the ceiling to avoid any device to lessen the admeasurement by making the ceiling thicker at the point cut by the sections. Care must also be taken that the sections shall be parallel to each other and at right angles to the axis of the vessel.

The intervals and one-third intervals of the breadths are to be carried to the nearest hundredth of a foot, and the interval and one-third interval of the length to the nearest thousandth of a foot.

No part of any vessel will be admeasured or registered for tonnage that is used for cabins or staterooms, and constructed entirely above the first deck, which is not a deck to the hull. (R. S., 4151.)

Any deck is a deck to the hull which has a direct bearing upon the frame timbers, even though lighter than other decks in the same vessel, and though only a portion of the timbers extend to such deck. In iron vessels an upper deck supported by stanchions of wood or iron bolted to the angle irons or to the iron plating of the vessel is to be taken as a deck to the hull.

In consequence of the diversity of modes of construction, much in this particular must necessarily be confided to the judgment of the measuring officer, but in case of doubt the facts should be submitted to the Commissioner of Navigation.

The law above referred to was designed merely to exclude cabins and staterooms above the "promenade" deck of the steamers of the seacoast and lakes or above a "boiler" deck as used on the western rivers. It does not have the effect to exempt from admeasurement any closed-in place, even if so situated, if used for cargo or stores.

A lack of uniformity has existed in the admeasurement of stern-wheel steamboats, especially of the type plying on western rivers, with engines and freight space above the first deck and not having a second deck which can properly be considered such a deck to the hull within the definition given above as to constitute it a "tonnage deck." Such vessels shall be so admeasured under article 82 as to include only in the gross tonnage the space under the first deck, and also the space or spaces above such deck available for cargo or stores or for the berthing or accommodation of passengers or crew, as mentioned above, exclusive of spaces used for cabins or staterooms, and constructed entirely "above the first deck, which is not a deck to the hull."

Freight space and boiler space on the main deck of a stern-wheel steamer (such as are used on western rivers), open at the sides and forward, and roofed over or covered by a canopy, awning, or shade deck, supported by stanchions not having a direct bearing upon the frames, being open to the sea and weather, and the deck above not being a deck to the hull within the meaning of the regulations, will not be measured or included in the vessel's tonnage.

ART. 82. *Special rules and definitions.*—If the second deck from the keel consists of several partial decks extending with breaks from stem to stern, the line of that course of decks must be taken as the tonnage deck; and if the partial decks are at different heights the line of the lowest will be taken as the tonnage deck, and the head room above such line under the higher will be measured.

By "closed-in spaces" is to be understood spaces which are sheltered from the action of the sea and weather, even though openings be left in the inclosure. Measuring officers will exercise due vigilance that the intent of the law in this respect is not evaded.

It should be borne in mind, however, that no closed-in spaces above the upper deck to the hull are to be admeasured unless available for cargo or stores or the berthing or accommodation of passengers or crew. The engine room, pilot house, galley, windlass house, and the like are, when so situated and used, exempt.

Spaces having angular recesses in their sides, as the freight room in figure 2, plate 4, are to be admeasured in parts. (R. S., 4150, 4153.)

On side-wheel steamers of the western rivers the space between the "doctor" and the first stanchion aft is to be allowed for gangway. But if the first stanchion be more than 6 feet aft of the "doctor," then an allowance of 6 feet only is to be made for gangway. Allow also at the sides of the engine frame the width of the footboard of the engineer. (See Diagram 5.)

On stern-wheel steamers of the western rivers make the same allowance for gangway aft the boilers as is made for gangway aft the "doctor" on side-wheel steamers. The freight room is to be measured from the gangway aft to the "doctor."

If any portion of the space aft the "doctor" of stern-wheel steamers be available for cargo, stores, passengers, or crew, it also must be admeasured.

ART. 83. *Marking and recording of tonnage.*—The tonnage (omitting fractions) must be marked on the face of the beam under the forward side of the main hatch of seagoing vessels and lake vessels, and on the face of the beam under the after side of the starboard forward hatch of western river steamers. On river steamers of the coast which carry passengers both above and below main deck, where there is no hatch to the main deck, the tonnage mark should be made on one of the deck beams in a conspicuous place, and as near as possible to the middle of the vessel. It should be in plain Arabic numerals, thus 825, and not less than 3 inches high and not less than three-eighths of an inch deep.

On vessels whose main beam is of wood, it should be deeply carved or branded, and on vessels whose main beam is of steel or iron it should be plainly cut, or marked in oil paint, white when the beam is black, and black when the beam is of any light color.

The measurement and calculations being complete, and the tonnage duly marked on the main beam, the surveyor or measuring officer will certify the result to the collector, and such certificate form (catalogue No. 1322) will be preserved as a permanent record in the customhouse.

Blanks of this form should be furnished to the measuring officer, and the measurements should be inserted therein as they are taken, and the computations carried out on the same sheet. Great care will be requisite to insure accuracy in measurements and calculations. They should be verified at least twice, and for those competent to construct it the line of areas shown in diagram 3 will be found of great use for that purpose.

ART. 84. *Change of tonnage.*—The tonnage of any documented vessel of the United States expressed in her marine papers in pursuance of a measurement purporting to be in conformity to this rule can be changed or set aside only by the Commissioner of Navigation, so long as the vessel remains unchanged in form or burden. Applications from any quarter for amendment or revision in such cases must be submitted to the Commissioner of Navigation, with precise statements of the errors supposed to exist.

ART. 85. *Measurement of foreign vessels.*—The tonnage of foreign vessels is to be ascertained when necessary for the assessment of tonnage tax, by the same rules, and a like certificate filed in the customhouse. On request, the collector will furnish to the master of the foreign vessel an abstract on catalogue No. 1414 of the admeasurement of his vessel, which will be accepted at other ports as denoting the correct tonnage of the vessel, unless she shall have undergone alteration.

A similar mode of admeasurement having been adopted by Great Britain, Belgium, Denmark, Austria-Hungary, the German Empire, Italy, Sweden, Norway, Spain, the Netherlands, Russia, Finland, Portugal, and Japan, and the like courtesy having been extended to vessels of the United States, it is directed that vessels of those countries whose registers indicate their gross and net tonnage under their present law shall be taken in ports of the United States to be of the tonnage so expressed in their documents, with the addition of the amount of the deductions and omissions made under such law not authorized by the admeasurement law of the United States.

Usually the gross and net tonnage may be ascertained from the register. In such cases the vessel will be entirely exempt from admeasurement.

When vessels of France are provided with a special certificate of admeasurement, showing the tonnage as ascertained in accordance with the admeasurement laws of the United States, the tonnage shall be accepted in ports of the United States, but in cases of doubt the matter should be submitted to the Commissioner of Navigation.

ART. 86. *Deductions from gross tonnage.*—The marine document of a vessel of the United States shall state separately the deductions made from the gross tonnage and shall also state the net or register tonnage of the vessel.

The excepted spaces will not be divided into sections, but each space will be admeasured as a whole. For certificate of admeasurement, see catalogue Nos. 1410, 1410a, 1410b.

From the gross tonnage of every vessel of the United States there shall be deducted—

(*a*) The tonnage of the spaces or compartments occupied by or appropriated to the use of the crew of the vessel. Every place so occupied shall be kept free from goods or stores of any kind not being the personal property of the crew in use during the voyage; and if any such place is not so kept free the master shall forfeit and pay to each seaman or apprentice lodged in that place the sum of 50 cents a day for each day during which any goods or stores as aforesaid are kept or stored in the place after complaint has been made to him by any two or more of the seamen so lodged. No deduction from tonnage as aforesaid shall be made unless there is permanently cut in a beam and over the doorway of every such place the number of men it is allowed to accommodate, with these words: "Certified to accommodate ——— seamen."

Every place appropriated to the crew of a seagoing vessel of the United States, except a fishing vessel, yacht, a pilot boat, and all vessels under 200 tons register, shall have a space of not less than 72 cubic feet and not less than 12 square feet measured on the deck or floor of that place for each seaman or apprentice lodged therein: *Provided,* That any such seagoing sailing vessel, built or rebuilt after June 30, 1898, shall have a space of not less than 100 cubic feet, and not less than 16 square feet measured on the deck or floor of that space for each seaman or apprentice lodged therein. Such place shall be securely constructed, properly lighted, drained, heated, and ventilated, properly protected from weather and sea, and, as far as practicable, properly shut off and protected from the effluvium of cargo or bilge water. (Cir. Apr. 1, 1897.)

Fishing vessels, yachts, and pilot boats are specifically exempted from the provision of section 1 of the act of March 2, 1895, so far as regards the amount of space which shall be appropriated to the crew, and from the provision that said space shall be kept free from goods or stores not being the personal property of the crew in use during the voyage. (Act of Mar. 3, 1897.)

Every steamboat of the United States plying upon the Mississippi River or its tributaries shall furnish an appropriate place for the crew, which shall conform to the requirements of this section, so far as they shall be applicable thereto, by providing sleeping room in the engine room of the steamboats properly protected from the cold, winds, and rain by means of suitable awnings or screens on either side of the guards or sides and forward, reaching from the boiler deck to the lower or main deck, under the direction and approval of the Supervising Inspector General of Steam Vessels, and shall be properly heated.

(*b*) Any space exclusively for the use of the master certified by the collector to be reasonable in extent and properly constructed, and the words "Certified for the accommodation of master" to be permanently cut in a beam and over the door of such space.

(*c*) Any space used exclusively for the working of the helm, the capstan, and the anchor gear, or for keeping the charts, signals, and other instruments of navigation and boatswain's stores, and the words "Certified for steering gear," or "Certified for boatswain's stores," or "Certified chart house," as the case may be, to be permanently cut in the beam and over the doorway of each of such spaces.

(*d*) The space occupied by the donkey engine and boiler, if connected with the main pumps of the ship.

(*e*) In the case of a ship propelled wholly by sails any space, not exceeding $2\frac{1}{2}$ per cent of the gross tonnage, used exclusively for the storage of sails: *Provided,* That spaces deducted shall be certified by the collector to be reasonable in extent and properly and efficiently constructed for the purposes for which they are intended, and the words "Certified for storage of sails" to be cut on the beam and over the doorway of such space.

(*f*) In the case of a ship propelled by steam or other power requiring engine room, a deduction for the space occupied by the propelling power shall be made as follows:

In ships propelled by paddle wheels in which the tonnage of the space occupied by and necessary for the proper working of the boilers and machinery is above 20 per cent and under 30 per cent of the gross tonnage, the deduction shall be 37 per cent of the gross tonnage; and in ships propelled by screws in which the tonnage of the space is above 13 per cent and under 20 per cent of the gross tonnage, the deduction shall be 32 per cent of the gross tonnage. In the case of screw steamers the contents of the trunk shaft shall be deemed spaces necessary for the proper working of the machinery.

(*g*) In the case of other vessels in which the actual space occupied by the propelling machinery amounts in the case of paddle vessels to 20 per cent or under and in the case of screw vessels to 13 per cent or under of the gross tonnage of the ship, the deduction shall consist in the case of paddle vessels of one and a half times the tonnage of the actual machinery space and in the case of screw vessels of one and three-fourths times the tonnage of the actual machinery space. But if the actual machinery space is so large as to amount in the case of paddle vessels to 30 per cent or above, and in the case of screw vessels to 20 per cent or above, of the gross tonnage of the ship, the deduction shall consist of 37 per cent of the gross tonnage of the ship in the

case of a paddle vessel and 32 per cent of the gross tonnage in the case of a screw vessel; or if the owner prefers there shall be deducted from the gross tonnage of the vessel the tonnage of the space or spaces actually occupied by or required to be inclosed for the proper working of the boilers and machinery, including the trunk shaft or alley in screw steamers with the addition in the case of vessels propelled with paddle wheels of 50 per cent, and in the case of vessels propelled by screws of 75 per cent, of the tonnage of such space.

(*h*) If there be a break, a poop, or any other permanent closed-in space on the upper deck available for cargo or stores, or for the berthing or accommodation of passengers or crew, the tonnage of that space shall be ascertained and added to the gross tonnage: *Provided*, That nothing shall be added to the gross tonnage for any sheltered space above the upper deck which is under cover and open to the weather; that is, not inclosed.

(*i*) On a request in writing to the Commissioner of Navigation by the owners of a ship the tonnage of such portion of the space or spaces above the crown of the engine room and above the upper deck as is framed in for the machinery or for the admission of light and air and not required to be added to gross tonnage shall, for the purpose of ascertaining the tonnage of the space occupied by the propelling power, be added to the tonnage of the engine space; but it shall then be included in the gross tonnage; such space or spaces must be reasonable in extent, safe, and seaworthy, and can not be used for any purpose other than the machinery, or for the admission of light and air to the machinery, or for the admission of light and air to the machinery or boilers of the ship.

And the proper deduction from the gross tonnage having been made, the remainder shall be deemed the net or register tonnage of such vessels.[1]

The register or other official certificate of the tonnage or nationality of a vessel of the United States, in addition to what is now required by law to be expressed therein, shall state separately the deductions made from the gross tonnage, and shall also state the net or registered tonnage of the vessel.

The outstanding registers or enrollments of vessels of the United States shall not be rendered void by the addition of such new statement of her tonnage, unless voluntarily surrendered; but the same may be added to the outstanding document or by an appendix thereto, with a certificate of a collector of customs that the original estimate of tonnage is amended.

In the case of a ship constructed with a double bottom for water ballast, if the space between the inner and outer plating thereof is certified by the collector to be not available for the carriage of cargo, stores, or fuel, then the depth of the vessel shall be taken to be the upper side of the inner plating of the double bottom, and that upper side shall, for the purposes of measurement, be deemed to represent the floor timber.

Upon application by the owner or master of an American vessel in foreign trade, collectors of customs, under regulations to be approved by the Secretary of Commerce and Labor, are authorized to attach to the register of such vessel an appendix stating separately, for use in foreign ports, the measurement of such space or spaces as are permitted to be deducted from gross tonnage by the rules of other nations and are not permitted by the laws of the United States.

These regulations shall not be construed to require the remeasurement of any American vessel duly measured before April 1, 1895; but upon application by the owner of any such vessel collectors of customs shall cause such vessel, or the spaces to be deducted, to be measured according to the provisions herein, and if a new register is not issued the statement of such remeasurement shall be attached by an appendix to the outstanding register or enrollment, with a certificate of the collector of customs that the original estimate of tonnage is amended pursuant to this act. The appendix granted should be inserted in the next papers issued.

On the issue of appendix the collector will advise the Bureau of Navigation of the vessel's new net tonnage, and if the appendix issue otherwise than at the vessel's home port he will also notify the collector at the home port.

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[1] The act of Congress of Feb. 6, 1909, contained the following clause, changing the deductions made from gross tonnage to determine net tonnage:

"From the gross tonnage there shall be deducted any other space adapted only for water ballast certified by the collector not to be available for the carriage of cargo, stores, supplies, or fuel."

On the readmeasurement of any vessel under the act of March 2,1895, and the issue of an appendix (cat. No. 1415), without surrender of marine documents, the proper customs officer will advise the Bureau of Navigation of the vessel's new net tonnage, by sending a copy of the appendix, and, if the appendix issue otherwise than at the vessel's home port, he will also notify the collector at such port. (Cir. March, 1896.)

No admeasurement under this article after being officially recorded shall be changed except on authority of the Commissioner of Navigation.

No space will be deducted from gross tonnage in ascertaining net tonnage unless it has been included in the gross tonnage.

The limitation of all deductions to 50 per cent of gross tonnage has been repealed.

The restriction of crew spaces to 5 per cent of the gross tonnage of the vessel has been repealed, and the actual spaces occupied by or appropriated to the use of the crew will be measured and deductions be made for them. But these spaces must be constructed according to the provisions of paragraph *a*, and a failure to comply with those requirements will be reported by the measurer to the collector of customs. No deduction from tonnage shall be made for crew spaces unless there is permanently cut in a beam and over the doorway of every such place the number of men it is allowed to accommodate, with these words, "Certified to accommodate ——— seamen." In spaces appropriated to the use of the crew may be included spaces necessary to shelter the cook when employed in the preparation of provisions and the engineer when employed in condensing water for the crew. Also water-closets or privies for the officers and crew. Mess rooms and bathrooms or wash rooms exclusively for the use of the officers or crew are included in the spaces appropriated to the use of the crew of the vessel. These spaces must be reasonable in extent, and if they are used by passengers no deduction shall be made.

The space, including sleeping room, dressing room, and bathroom for the use of the master will be stated separately on the certificate of registry. It must be exclusively for his use and certified to be reasonable in extent and properly constructed, and the words "Certified for the accommodation of master" must be permanently cut in a beam and over the door of such space.

Helm, capstan, and anchor gear spaces, the wheelhouse for sheltering the man at the wheel, spaces for keeping charts, signals, and other instruments of navigation, and boatswain's stores, must be reasonable in extent and marked according to law.

If the donkey engine and boiler are within the boundary of the engine room, and the machinery is used in connection with the main machinery, the space occupied by them is not entitled to a separate deduction in addition to the deduction made for propelling power.

The gross tonnage of the hold of steam vessels should be ascertained when the hold is sufficiently complete and clear for the purpose before the building and fitting of the actual engine room, and measurers should be notified by builders when steam vessels have reached the point of construction which permits gross tonnage to be ascertained.

The actual space occupied by the boilers, engines, and machinery will be ascertained according to the rules now in force, and this actual space will then be compared with the gross tonnage of the vessel.

When the actual space is between 20 and 30 per cent of the gross tonnage of a paddle vessel, 37 per cent of the gross tonnage shall be deducted for propelling power.

When the actual space is between 13 and 20 per cent of the gross tonnage of a screw vessel, 32 per cent of the gross tonnage shall be deducted for propelling power.

When the actual space is 20 per cent or less of the gross tonnage of a paddle vessel, multiply the actual space by 1.5 to obtain the deduction allowed for propelling power.

When the actual space is 13 per cent or less of the gross tonnage of a screw vessel, multiply the actual space by 1.75 to obtain the deduction allowed for propelling power.

When the actual space is 30 per cent or over of a paddle vessel and 20 per cent or over of a screw vessel the owner shall designate which method of deduction he elects:

(1) Paddle vessel—

(*a*) Thirty-seven per cent of gross tonnage.

(*b*) Actual space, multiplied by 1.5.

(2) Screw vessel—

(*a*) Thirty-two per cent of gross tonnage.

(*b*) Actual space, multiplied by 1.75.

If the owner does not make a choice method (*a*) will be adopted.

If application for remeasurement of a steam vessel measured before April 1, 1895, to bring its certificate into accord with the provisions of the act of March 2, 1895, is made, it will not be necessary to measure the spaces for propelling power. Take the deduction for propelling power given in the outstanding certificate and, if the vessel be a screw vessel, divide that deduction by 1.75; if a paddle vessel, divide by 1.50, and the result will be the actual spaces occupied by boilers and engines. These actual spaces may then be compared with the gross tonnage, to ascertain the percentage and the rule according to which the new certificate of measurement shall be made out. Actual remeasurement is to be avoided if practicable, unless there is reason to believe the outstanding certificate of measurement is incorrect.

A request to the Commissioner of Navigation that spaces above the crown of the engine room and above the upper deck (framed in for machinery or for the admission of light and air and not required to be measured) be measured, in order to obtain the benefit of a higher deduction for propelling power, must be accompanied with a description and sketch or tracing of the spaces, the measurement thereof, and the collector's certificate that they conform to the requirements of paragraph (*i*) of the act.

Where the top of the double bottom for water ballast is horizontal the transverse areas will be measured as heretofore provided by law, but where there are breaks in the double bottom the length of the vessel will be taken in parts, according to the number of breaks, and each part divided into a number of equal parts, according to the classes in section 4153, Revised Statutes.

As the provisions of the act of March 2, 1895, are in substantial accord with the measurement laws of the principal maritime nations applications for an appendix, stating separately the measurement of spaces which may be deducted by the laws of other nations, but not by the laws of the United States, if there be any, should be referred to the Commissioner of Navigation.

ART. 87. *Shelter decks and upper decks.*—Whether for the purpose of measurement a deck is to be regarded as an upper deck or as the shelter to an upper deck is to be determined in each instance both by the character and structural conditions of the erection and by the purpose to which the between deck is devoted. Differences in construction are so numerous that no definition or rule on this subject has been formulated. If the deck is a continuous deck, fastened down and water-tight, sealing up the cylinder formed between the two decks and making it a fit place for the stowage of cargo, like a hold, the deck is to be treated as an upper deck and the space between it and the deck below is to be measured.

If, however, the cylinder is open to the shipment of seas, and the space is not reasonably fit for the carrying of dry cargo, but is used only for cargo generally classed as deck cargo, such as cattle, horses, chemicals, oil in barrels, etc., then, usually, the deck is to be regarded as a shelter deck, and the space as "sheltered space above the upper deck which is under cover and open to the weather; that is, not enclosed," and not to be included in the recorded tonnage.

In the registers of many foreign vessels only so much of the light and air space is added to the gross tonnage and to the propelling power as will bring the volume of the propelling power above the 13 per cent of the gross tonnage required to entitle the vessel to a deduction of 32 per cent of the gross tonnage.

If there are such additions, however, the computations should be substantially the same as if the vessel were measured under the regulations of the United States, which in paragraph (*i*), article 86, contemplate the measurement, subject to certain limitations when authorized by the Commissioner of Navigation, of the entire portion of the space above the crown of the engine

room and above the upper deck, which is framed in for the machinery or for the admission of light and air and not required to be added to the gross tonnage. The regulations do not sanction the addition of a part only of such space or spaces.

The addition of spaces, such as shelter deck, bridge, poop, deck space, etc., claimed to be open spaces but found to be closed, and available and used for cargo or stores, to the gross tonnage, often increases the latter to such an extent that the volume of the propelling power does not amount to 13 per cent of the gross tonnage without the addition of the light and air space omitted from the register and propelling power spaces.

In adding such light and air space, under the regulations cited, to arrive at the proper dutiable tonnage, computation should be made by admeasuring officers in the United States substantially in accordance with the following example:

The register of a certain foreign vessel shows tonnages as follows:

	Tons.	Tons.
Under tonnage deck	2,669.05	
Chart house	4.48	
Forecastle	38.06	
Round houses	64.99	
Excess hatchways	45.23	
Light and air	54.05	
Gross		2,875.86
Deductions:		
Propelling power (32 per cent)	920.28	
Crew	59.82	
Master	5.09	
Chart room	4.48	
Boatswain's stores	28.75	
		1,018.42
Net		1,857.44

In this case, to arrive at the proper dutiable tonnage, computations are made by the measuring officer in the United States as follows:

From foreign register, with requisite additions made in the United States:

	Tons.	Tons.
Under tonnage deck		2,669.05
Chart house		4.48
Forecastle		38.06
Round houses		64.99
Excess hatchways		45.23
Light and air		54.05
Bridge (added)		230.25
Poop (added)		65.67
Additional light and air (added)		36.05
Gross		3,207.83
Deductions:	Tons.	
Propelling power, plus 75 per cent	717.72	
Crew	59.82	
Master	5.09	
Chart room	4.48	
Boatswain's stores	28.75	
		815.86
Net		2,391.97

Showing an addition to the net tonnage of 534.53 tons.

The actual propelling power is	320.03
Total light and air space	90.10
Total	410.13
13 per cent of 3,207.83 (gross tonnage)	417.01
Actual propelling power, light and air added	410.13
Balance	6.88

Needed to entitle the vessel to a deduction of 32 per cent of the gross tonnage, which necessitates the use of form b, or 175 per cent of the propelling-power space.

Light and air space need not be measured in the United States when the register shows there was no omission from the tonnage of the vessel.

Masters should be required to present, on entering, any certificate of measurement granted at another American port.

Objection has been made that it is difficult to secure a correct admeasurement of the boiler and engine rooms after all the machinery has been set up, but the Bureau is advised that while the spaces may be dirty and the process of admeasuring intricate they can be admeasured.

APPENDIX III.

BRITISH LAWS CONCERNING THE MEASUREMENT OF VESSELS.

TEXT OF THE PRINCIPAL PROVISIONS OF THE MERCHANT SHIPPING ACT OF 1894 RELATING TO TONNAGE MEASUREMENT, AS AMENDED BY SUBSEQUENT ACTS.

APPENDIX III.

TEXT OF THE PRINCIPAL PROVISIONS OF THE MERCHANT SHIPPING ACT, 1894. RELATING TO TONNAGE MEASUREMENT, AS AMENDED BY SUBSEQUENT ACTS.

6. *Survey and measurement of ship.*—Every British ship shall before registry be surveyed by a surveyor of ships, and her tonnage ascertained in accordance with the tonnage regulations of this act, and the surveyor shall grant his certificate specifying the ship's tonnage and build, and such other particulars descriptive of the identity of the ship as may for the time being be required by the Board of Trade, and such certificate shall be delivered to the registrar before registry.

7. *Marking of ship.*—(1) Every British ship shall, before registry, be marked permanently and conspicuously to the satisfaction of the Board of Trade, as follows:

(*a*) Her name shall be marked on each of her bows, and her name and the name of her port of registry must be marked on her stern, on a dark ground in white or yellow letters, or on a light ground in black letters, such letters to be of a length not less than 4 inches, and of proportionate breadth.

(*b*) Her official number and the number denoting her registered tonnage shall be cut in on her main beam.

(*c*) A scale of feet denoting her draft of water shall be marked on each side of her stem and of her stern post in Roman capital letters or in figures, not less than 6 inches in length, the lower line of such letters or figures to coincide with the draft line denoted thereby, and those letters or figures must be marked by being cut in and painted white or yellow on a dark ground, or in such other way as the Board of Trade approve.

(2) The Board of Trade may exempt any class of ships from all or any of the requirements of this section, and a fishing boat entered in the fishing-boat register, and lettered and numbered in pursuance of the fourth part of this act, need not have her name and port of registry marked under this section.

(3) If the scale of feet showing the ship's draft of water is in any respects inaccurate, so as to be likely to mislead, the owner of the ship shall be liable to a fine not exceeding £100.

(4) The marks required by this section shall be permanently continued, and no alteration shall be made therein, except in the event of any of the particulars thereby denoted being altered in the manner provided by this act.

(5) If an owner or a master of a British ship neglects to cause his ship to be marked as required by this section, or to keep her so marked, or if any person conceals, removes, alters, defaces, or obliterates, or suffers any person under his control to conceal, remove, alter, deface, or obliterate any of the said marks, except in the event aforesaid, or except for the purpose of escaping capture by an enemy, that owner, master, or person shall for each offense be liable to a fine not exceeding £100, and on a certificate from a surveyor of ships, or Board of Trade inspector under this act, that a ship is insufficiently or inaccurately marked, the ship may be detained until the insufficiency or inaccuracy has been remedied.

48. *Registry of alterations.*—(1) When a registered ship is so altered as not to correspond with the particulars relating to her tonnage or description contained in the register book, then,

if the alteration is made at any port having a registrar, that registrar, or, if it is made elsewhere, the registrar of the first port having a registrar at which the ship arrives after the alteration, shall, on application being made to him and on receipt of a certificate from the proper surveyor stating the particulars of the alteration, either cause the alteration to be registered, or direct that the ship be registered anew.

(2) (*M. S. Act, 1906, sec. 53.*)—If default is made in registering anew a ship, or in registering an alteration of a ship so altered as aforesaid, the owner of the ship shall be liable on summary conviction to a fine not exceeding £100, and in addition to a fine not exceeding £5 for every day during which the offense continues after conviction.

77. *Rules for ascertaining register tonnage.*—(1) The tonnage of every ship to be registered, with the exceptions hereinafter mentioned, shall, previously to her being registered, be ascertained by Rule I in the second schedule to this act, and the tonnage of every ship to which that Rule I can be applied, whether she is about to be registered or not, shall be ascertained by the same rule.

(2) Ships which, requiring to be measured for any purpose other than registry, have cargo on board, and ships which, requiring to be measured for the purpose of registry, can not be measured by Rule I, shall be measured by Rule II in the said schedule, and the owner of any ship measured under Rule II may at any subsequent period apply to the Board of Trade to have the ship remeasured under Rule I, and the board may thereupon, upon payment of such fee, not exceeding 7 shillings and 6 pence for each transverse section as they may authorize, direct the ship to be remeasured accordingly, and the number denoting the register tonnage shall be altered accordingly.

(3) For the purpose of ascertaining the register tonnage of a ship the allowance and deductions hereinafter mentioned shall be made from the tonnage of the ship ascertained as aforesaid.

(4) In the measurement of a ship for the purpose of ascertaining her register tonnage, no deduction shall be allowed in respect of any space which has not been first included in the measurement of her tonnage.

(5) In ascertaining the tonnage of open ships Rule IV in the said schedule shall be observed.

(6) Throughout the rules in the second schedule to this act, the tonnage deck shall be taken to be the upper deck in ships which have less than three decks, and to be the second deck from below in all other ships, and in carrying those rules into effect all measurements shall be taken in feet, and fractions of feet shall be expressed in decimals.

(7) The Board of Trade may make such modifications and alterations as from time to time become necessary in the rules in the second schedule to this act for the purpose of the more accurate and uniform application thereof, and the effectual carrying out of the principle of measurement therein adopted.

(8) The provisions of this act relating to tonnage, together with the rules for the time being in force, are in this act referred to as the tonnage regulations of this act.

78. *Allowance for engine-room space in steamships.*—(1) In the case of any ship propelled by steam or other power requiring engine room, an allowance shall be made for the space occupied by the propelling power, and the amount so allowed shall be deducted from the gross tonnage of the ship ascertained as in the last preceding section mentioned, and the remainder shall (subject to any deductions hereinafter mentioned) be deemed to be the registered tonnage of the ship, and that deduction shall be estimated as follows (that is to say):

(*a*) As regards ships propelled by paddle wheels in which the tonnage of the space solely occupied by and necessary for the proper working of the boilers and machinery is above 20 per cent and under 30 per cent of the gross tonnage of the ship, the deduction shall be thirty-seven one-hundredths of the gross tonnage; and in ships propelled by screws, in which the tonnage of such space is above 13 per cent and under 20 per cent of the gross tonnage, the deduction shall be thirty-two one-hundredths of the gross tonnage.

(*b*) As regards all other ships, the deduction shall, if the Board of Trade and the owner both agree thereto, be estimated in the same manner; but either they or he may, in their or his discretion, require the space to be measured and the deduction estimated accordingly; and whenever the measurement is so required, the deduction shall consist of the tonnage of the space actually occupied by or required to be inclosed for the proper working of the boilers and machinery, with the addition in the case of ships propelled by paddle wheels of one-half, and in the case of ships propelled by screws of three-fourths of the tonnage of the space; and in the case of ships propelled by screws, the contents of the shaft trunk shall be added to and deemed to form part of the space; and the measurement of the space shall be governed by Rule III in the second schedule to this act.

(2) Such portion of the space above the crown of the engine room and above the upper deck as is framed in for the machinery or for the admission of light and air shall not be included in the measurement of the space occupied by the propelling power, except in pursuance of a request in writing to the Board of Trade by the owner of the ship, but shall not be included in pursuance of that request unless—

(*a*) That portion is first included in the measurement of the gross tonnage; and

(*b*) A surveyor of ships certifies that the portion so framed in is reasonable in extent and is so constructed as to be safe and seaworthy, and that it can not be used for any purpose other than the machinery or for the admission of light and air to the machinery or boilers of the ship.

(3) Goods or stores shall not be stowed or carried in any space measured for propelling power, and if the same are so carried in any ship, the master and owner of the ship shall each be liable to a fine not exceeding £100.

Restriction on deduction for space occupied by propelling power (*M. S. Act, 1907*).—1. The deduction under section 78 of the Merchant Shipping Act, 1894 (in this act referred to as "the principal act"), for the space occupied by the propelling power of a ship shall not in any case exceed 55 per cent of that portion of the tonnage of the ship which remains after deducting from the gross tonnage any deductions allowed under section 79 of the principal act: Provided that—

(*a*) This section shall not apply to steamships constructed for the purpose of towing vessels so long as they are exclusively employed as tugs, but if and when employed for the carriage of passengers, cargoes, or stores, or using graving docks or dry docks or places provided for the repairing of vessels the register tonnage on which dues based on register tonnage may be levied by any harbor or dock authority shall be ascertained in manner provided by the Merchant Shipping Acts, 1894 to 1906, as amended by this act; and

(*b*) This section shall not come into operation until the 1st day of January, 1914, in the case of the following ships (in this act referred to as existing ships), namely, ships constructed, or the construction of which has been commenced, before the 1st day of May, 1907, and ships a contract for the construction of which has been made before the 1st day of May, 1907, though the construction has not actually commenced before that date.

Provisions as to ships already registered.—3. (1) Where, in ascertaining the tonnage of an existing ship, a deduction has been made for the space occupied by the propelling power of the ship greater than the maximum deduction allowed under this act, the tonnage of the ship shall, before the date on which this act comes into operation as respects that ship, be recalculated on the basis of allowing the maximum deduction under this act instead of that previously allowed, and the necessary alteration of the particulars and certificate of the registry of the ship shall be made and shall take effect on that date.

(2) The registrar of every port of registry shall make any alteration in the particulars of the registry of any ship registered at that port, which is required for the purposes of this section, and shall send notice of the alteration so made to the managing owner of the ship.

(3) The managing owner of the ship, on the receipt of any such notice of alteration, shall forthwith transmit the notice to the master of the ship, and the master of the ship on receipt

of the notice shall produce it to the registrar of the port at which the ship is when the notice is received, if that port is a port having a registrar, and if not to the registrar of the first port having a registrar at which the ship arrives after the notice is received, and the registrar shall alter the certificate of registry of the ship in accordance with the notice.

(4) If the managing owner or master of a ship fails to comply with the provisions of this section, the managing owner or master, as the case may be, shall be liable on summary conviction, in respect of each offense, to a fine not exceeding £50.

(5) The expression "managing owner" in this section includes any person registered under section 59 of the principal act in cases where there is no managing owner.

79. *Deductions for ascertaining tonnage.*—(1) In measuring or remeasuring a ship for the purpose of ascertaining her register tonnage, the following deductions shall be made from the space included in the measurement of the tonnage, namely:

(*a*) In the case of any ship—

(i) Any space used exclusively for the accommodation of the master; and any space occupied by seamen or apprentices and appropriated to their use, which is certified under the regulations scheduled to this act with regard thereto;

(ii) Any space used exclusively for the working of the helm, the capstan, and the anchor gear, or for keeping the charts, signals, and other instruments of navigation, and boatswain's stores; and

(iii) The space occupied by the donkey engine and boiler, if connected with the main pumps of the ship; and

(iv) (*M. S. Act, 1906, Sec. 54 (1).*)—Any space (other than a double bottom) adapted only for water ballast; and

(*b*) In the case of a ship wholly propelled by sails, any space set apart and used exclusively for the storage of sails.

(*M. S. Act, 1906, sec. 54 (2).*)—For the purpose of obtaining the benefit of a deduction under [subsection (1) (*a*) (iv) of] this section the owner of any existing ship who claims to be entitled to the deduction may apply to the Board of Trade to have the necessary remeasurements of his ship made, and the Board of Trade, on the payment of such fee, not exceeding in any case one-fifth of the corresponding maximum fee fixed by the third schedule to the principal act, as they may authorize, shall direct those measurements to be made, and the number denoting the register tonnage shall be altered accordingly.

(2) The deductions allowed under this section, other than a deduction for a space occupied by seamen or apprentices, and certified as aforesaid, shall be subject to the following provisions, namely:

(*a*) The space deducted must be certified by a surveyor of ships as reasonable in extent and properly and efficiently constructed for the purpose for which it is intended;

(*b*) There must be permanently marked in or over every such space a notice stating the purpose to which it is to be applied, and that while so applied it is to be deducted from the tonnage of the ship;

(*c*) The deduction on account of space for storage of sails must not exceed $2\frac{1}{2}$ per cent of the tonnage of the ship.

81. *Measurement of ships with double bottoms for water ballast.*—In the case of a ship constructed with a double bottom for water ballast, if the space between the inner and outer plating thereof is certified by a surveyor of ships to be not available for the carriage of cargo, stores, or fuel, then the depth required by the provisions of Rule I, relating to the measurement of transverse areas, shall be taken to be the upper side of the inner plating of the double bottom, and that upper side shall, for the purposes of measurement, be deemed to represent the floor timber referred to in that rule.

82. *Tonnage once ascertained to be the tonnage of ship.*—Whenever the tonnage of any ship has been ascertained and registered in accordance with the tonnage regulations of this act,

the same shall thenceforth be deemed to be the tonnage of the ship and shall be repeated in every subsequent registry thereof, unless any alteration is made in the form or capacity of the ship, or unless it is discovered that the tonnage of the ship has been erroneously computed; and in either of those cases the ship shall be remeasured and her tonnage determined and registered according to the tonnage regulations of this act.

84. *Tonnage of ships of foreign countries adopting tonnage regulations.*—(1) Whenever it appears to Her Majesty the Queen in Council that the tonnage regulations of this act have been adopted by any foreign country and are in force there, Her Majesty in Council may order that the ships of that country shall, without being remeasured in Her Majesty's dominions, be deemed to be of the tonnage denoted in their certificates of registry or other national papers, in the same manner, to the same extent, and for the same purposes as the tonnage denoted in the certificate of registry of a British ship is deemed to be the tonnage of that ship.

(2) Her Majesty in Council may limit the time during which the order is to remain in operation and make the order subject to such conditions and qualifications (if any) as Her Majesty may deem expedient, and the operation of the order shall be limited and modified accordingly.

(3) If it is made to appear to Her Majesty that the tonnage of any foreign ship, as measured by the rules of the country to which she belongs, materially differs from that which would be her tonnage if measured under this act, Her Majesty in Council may order that, notwithstanding any order in council for the time being in force under this section, any of the ships of that country may, for all or any of the purposes of this act, be remeasured in accordance with this act.

85. *Space occupied by deck cargo to be liable to dues.*—(1) If any ship, British or foreign, other than a home-trade ship as defined by this act, carries as deck cargo, that is to say, in any uncovered space upon deck, or in any covered space not included in the cubical contents forming the ship's registered tonnage, timber, stores, or other goods, all dues payable on the ship's tonnage shall be payable as if there were added to the ship's registered tonnage the tonnage of the space occupied by those goods at the time at which the dues become payable.

(2) The space so occupied shall be deemed to be the space limited by the area occupied by the goods and by straight lines inclosing a rectangular space sufficient to include the goods.

(3) The tonnage of the space shall be ascertained by an officer of the Board of Trade or of Customs in manner directed as to the measurement of poops or other closed-in spaces by Rule I in the second schedule to this act, and when so ascertained shall be entered by him in the ship's official log book and also in a memorandum which he shall deliver to the master, and the master shall, when the said dues are demanded, produce that memorandum in like manner as if it were the certificate of registry, or, in the case of a foreign ship, the document equivalent to a certificate of registry, and in default shall be liable to the same penalty as if he had failed to produce the said certificate or document.

(4) Nothing in this section shall apply to any ship employed exclusively in trading or going from place to place in any river or inland water of which the whole or part is in any British possession or to deck cargo carried by a ship while engaged in the coasting trade of any British possession.

86. *Surveyors and regulations for measurement of ships.*—All duties in relation to the survey and measurement of ships shall be performed by surveyors of ships under this act in accordance with regulations made by the Board of Trade.

80. *Power to register Government ships under the Merchant Shipping Acts (M. S. Act, 1906).*—(1) His Majesty may by order in council make regulations with respect to the manner in which Government ships may be registered as British ships for the purpose of the Merchant Shipping Acts and those acts subject to any exceptions and modifications which may be made by order in council, either generally or as respects any special class of Government ships, shall apply to Government ships registered in accordance with those regulations as if they were registered in manner provided by those acts.

(2) Nothing in this act shall affect the powers of the legislature of any British possession to regulate any Government ships under the control of the Government of that possession.

(3) In this section the expression "Government ships" means ships not forming part of His Majesty's Navy which belong to His Majesty or are held by any person on behalf of or for the benefit of the Crown, and for that reason can not be registered under the principal act.

743. *Application of act to ships propelled by electricity, etc.*—Any provisions of this act applying to steamers or steamships shall apply to ships propelled by electricity or other mechanical power, with such modifications as the Board of Trade may prescribe for the purpose of adaptation.

Second Schedule.—Rules as to the Measurement of Tonnage.

Rule I as modified by sec. 81 (measurement of vessels with double bottoms for water ballast) and by the Board of Trade under sec. 77 (7) of the act.

(*The modifications are shown by italics.*)

(1) *Measurement of ships to be registered, and other ships of which the hold is clear—Lengths.*—Measure the length of the ship in a straight line along the upper side of the tonnage deck from the inside of the inner plank (average thickness) at the side of the stem to the inside of the midship stern timber or plank there, as the case may be (average thickness), deducting from this length what is due to the rake of the bow in the thickness of the deck and what is due to the rake of the stern timber in the thickness of the deck, and also what is due to the rake of the stern timber in one-third of the round of the beam; divide the length so taken into the number of equal parts required by the following table, according to the class in such table to which the ship belongs:

Table.

Class 1. Ships of which the tonnage deck is, according to the above measurement, 50 feet long or under, into four equal parts.

Class 2. Ships of which the tonnage deck is, according to the above measurement, above 50 feet long and not exceeding 120, into six equal parts.

Class 3. Ships of which the tonnage deck is according to the above measurement above 120 feet long, and not exceeding 180, into 8 equal parts.

Class 4. Ships of which the tonnage deck is according to the above measurement above 180 feet long, and not exceeding 225, into 10 equal parts.

Class 5. Ships of which the tonnage deck is according to the above measurement above 225 feet long, into 12 equal parts.

In the case of a break or breaks in a double bottom for water ballast, the length of the vessel is to be taken in parts according to the number of breaks, and each part divided into a number of equal parts according to the class in the above table to which such length belongs.

(2) *Transverse areas.*—Then, the hold being first sufficiently cleared to admit of the required depths and breadths being properly taken, find the transverse area of the ship at each point of division of the length *or each point of division of the parts of the length, as the case may require,* as follows: Measure the depth at each point of division from a point at a distance of one-third of the round of the beam below the tonnage deck, or, in case of a break, below a line stretched in continuation thereof, to the upper side of the floor timber (*upper side of the inner plating of the double bottom*)[1] at the inside of the limber strake, after deducting the average thickness of the ceiling which is between the bilge planks and the limber strake; then, if the depths at the midship division of the length do not exceed 16 feet, divide each depth into *five*[2] equal parts; then measure the inside horizontal breadth at each of the *four* points of division, and

[1] *See* Section 81, Merchant Shipping Act, 1894.

[2] *See* Report of Royal Commission on Tonnage, p. 799.

also at the upper point of the depth, extending each measurement to the average thickness of that part of the ceiling which is between the points of measurement; number these breadths from above (*i. e.*, numbering the upper breadth 1, and so on down to the *fifth* breadth); multiply the second and fourth by 4, and the third by 2; add these products together, and to the sum add the first breadth and the fifth; multiply the quantity thus obtained by one-third of the common interval between the breadths, and the product shall be deemed the transverse area *of the upper part of the section; then find the area between the fifth and lower point of the depth by dividing the depth between such points into four equal parts and measure the horizontal breadths at the three points of division and also at the upper and lower points, and proceed as before, and the sum of two parts shall be deemed to be the transverse area;* but if the midship depth exceed 16 feet, divide each depth into *seven* equal parts instead of four, and measure as before directed the horizontal breadths at the *six* points of division, and also at the upper point of the depth; number them from above as before; multiply the second, fourth, and sixth by 4 and the third and fifth by 2; add these products together, and to the sum add the first breadth and the seventh; multiply the quantity thus obtained by one-third of the common interval between the breadths, and the products shall be deemed the transverse area *of the upper part of the section; then find the lower part of the area as before directed, and add the two parts together, and the sum shall be deemed to be the transverse area.*

In all cases where the top of the double bottom is horizontal it will be sufficient to measure the transverse areas under the ordinary words of the law.

(3) *Computation from areas.*—Having thus ascertained the transverse area at each point of division of the length of the ship, *or each point of division of the parts of the length, as the case may require,* as required by the above table, proceed to ascertain the register tonnage under the tonnage deck in the following manner: Number the areas, respectively, 1, 2, 3, etc., No. 1 being at the extreme limit of the length at the bow, *or of each part of the length,* and the last number at the extreme limit of the length at the stern, *or the extreme limit at the after end of each part of the length;* then whether the length be divided according to the table into 4 or 12 parts, as in classes 1 and 5, or any intermediate number, as in classes 2, 3, and 4, multiply the second and every even-numbered area by 4, and the third and every odd-numbered area (except the first and last) by 2; add these products together, and to the sum add the first and last if they yield anything; multiply the quantity thus obtained by one-third of the common interval between the areas, and the product will be the cubical contents of the space, *or cubical contents of each part if the ship is measured in parts* under the tonnage deck; divide this product, *or if measured in parts the products of the several parts added together,* by 100, and the quotient, being the tonnage under the tonnage deck, shall be deemed to be the register tonnage of the ship, subject to any additions and deductions under this act.

(4) *In case of decks above the tonnage deck.*—If the ship has a third deck, commonly called a spar deck, the tonnage of the space between it and the tonnage deck shall be ascertained as follows: Measure in feet the inside length of the space at the middle of its height from the plank at the side of the stem to the lining on the timbers at the stern, and divide the length into the same number of equal parts into which the length of the tonnage deck is divided as above directed; measure (also at the middle of its height) the inside breadth of the space at each of the points of division, also the breadth at the stem and the breadth at the stern; number them successively 1, 2, 3, etc., commencing at the stem; multiply the second and all the other even-numbered breadths by 4, and the third and all the other odd-numbered breadths (except the first and last) by 2; to the sum of these products add the first and last breadths; multiply the whole sum by one-third of the common interval between the breadths, and the result will give in superficial feet the mean horizontal area of the space; measure the mean height of the space and multiply by it the mean horizontal area, and the product will be the cubical contents of the space; divide this product by 100 and the quotient shall be deemed to be the tonnage of the space and shall be added to the tonnage of the ship ascertained as aforesaid. If the ship has

more than three decks the tonnage of each space between decks above the tonnage deck shall be severally ascertained in manner above described, and shall be added to the tonnage of the ship ascertained as aforesaid.

(5) *Poop, deck house, forecastle, and any other closed-in space.*—If there be a break, a poop, or any other permanent closed-in space on the upper deck available for cargo or stores, or for the berthing or accommodation of passengers or crew, the tonnage of that space shall be ascertained as follows: Measure the internal mean length of the space in feet, and divide it into two equal parts; measure at the middle of its height three inside breadths, namely, one at each end and the other at the middle of the length; then to the sum of the end breadths add four times the middle breadth, and multiply the whole sum by one-third of the common interval between the breadths, the product will give the mean horizontal area of the space; then measure the mean height, and multiply by it the mean horizontal area; divide the product by 100 and the quotient shall be deemed to be the tonnage of the space, and shall be added to the tonnage under the tonnage deck ascertained as aforesaid. Provided that no addition shall be made in respect of any building erected for the shelter of deck passengers and approved by the Board of Trade.

RULE II. (AS MODIFIED BY THE BOARD OF TRADE UNDER SEC. 77 (7) OF THE ACT.)

(1) *Measurement of ships not requiring registry with cargo on board and ships which can not be measured under Rule I.—Length.—Breadth.—Girting of the ship.*—Measure the length on the uppermost deck from the outside of the outer plank at the stem to the aft side of the sternpost, deducting therefrom the distance between the aft side of the sternpost and the rabbet of the sternpost at the point where the counter plank crosses it; measure also the greatest breadth of the ship to the outside of the outer planking or wales, and then, having first marked on the outside of the ship on both sides thereof the height of the upper deck at the ship's sides, girt the ship at the greatest breadth in a direction perpendicular to the keel from the height so marked on the outside of the ship on the one side to the height so marked on the other side by passing a chain under the keel; to half the girth thus taken add half the main breadth; square the sum; multiply the result by the length of ship taken as aforesaid; then multiply this product by the factor *.0017* (*seventeen* ten-thousandths) in the case of ships built of wood, and *.0018* (*eighteen* ten-thousandths) in the case of ships built of iron, and the product shall be deemed the register tonnage of the ship, subject to any additions and deductions under this act

(2) *Poop, deck house, forecastle, and other closed-in spaces on upper deck.*—If there be a break, a poop, or other closed-in space on the upper deck, the tonnage of that space shall be ascertained by multiplying together the mean length, breadth, and depth of the space, and dividing the product by 100, and the quotient so obtained shall be deemed to be the tonnage of the space, and shall be added to the tonnage of the ship ascertained as aforesaid.

RULE III.

Measurement of allowance for engine-room space in steamships.—(i) Measure the mean depth of the space from its crown to the ceiling at the limber strake, measure also three, or, if necessary, more than three, breadths of the space at the middle of its depth, taking one of those measurements at each end, and another at the middle of the length; take the mean of those breadths; measure also the mean length of the space between the foremost and aftermost bulkheads or limits of its length, excluding such parts, if any, as are not actually occupied by or required for the proper working of the machinery; multiply together these three dimensions of length, breadth, and depth, divide the product by 100, and the result shall be deemed the tonnage of the space below the crown; then find the cubical contents of the space or spaces, if any, above the crown aforesaid, which are framed in for the machinery or for the admission of light and air, by multiplying together the length, depth, and breadth thereof; add such contents to the cubical

contents of the space below the crown; divide the sum by 100; and the result shall (subject to the provisions hereinafter contained) be deemed to be the tonnage of the space.

(ii) If in any ship in which the space for propelling power is to be measured the engines and boilers are fitted in separate compartments, the contents of each shall be measured severally in like manner, according to the above rules, and the sum of their several results shall be deemed to be the tonnage of the said space.

(iii) In the case of screw steamers, in which the space for propelling power is to be measured, the contents of the shaft trunk shall be ascertained by multiplying together the mean length, breadth, and depth of the trunk, and dividing the product by 100.

(iv) If in any ship in which the space aforesaid is to be measured any alteration be made in the length or capacity of the spaces, or if any cabins be fitted in the space, the ship shall be deemed to be a ship not registered until remeasurement.

RULE IV.

IV. *Measurement of open ships.*—In ascertaining the tonnage of open ships the upper edge of the upper strake is to form the boundary line of measurement, and the depths shall be taken from an athwartship line, extending from upper edge to upper edge of the said strake at each division of the length.

Tonnage Measurement of Government Ships.

[Extracts from order in council dated March 22, 1911, respecting the registration of ships in the service of the Admiralty, but not forming part of the Royal Navy.]

7. The tonnage of Government ships in the service of the Admiralty shall be ascertained in accordance with tonnage regulations to be made by the Board of Trade with the concurrence of the Admiralty; and wherever reference is made to tonnage regulations or to the ascertainment of tonnage thereby in any sections of the Merchant Shipping Acts which are applicable to Government ships such sections shall be read with reference to Government ships as if the tonnage regulations made under this order in council were mentioned therein in lieu of the tonnage regulations mentioned in that act and any schedules thereto.

23. The following sections and provisions of the Merchant Shipping Acts shall not apply to Government ships in the service of the Admiralty registered in pursuance of the provisions of this order in council, namely:

The Merchant Shipping Act, 1894, sections 7 (3) and (5), 48, 84, 85.

The Merchant Shipping Act, 1906, section 53.

APPENDIX IV.

BRITISH BOARD OF TRADE INSTRUCTIONS RELATING TO THE MEASUREMENT OF SHIPS, 1913.

APPENDIX IV.

INSTRUCTIONS AS TO THE TONNAGE MEASUREMENT OF SHIPS.

[Issued by the Board of Trade, 1913.]

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NOTE.—This edition supersedes the edition issued in 1907. The contents have been rearranged and to a large extent rewritten; and the printed circulars and other instructions issued since 1907 have been embodied.

PART I.—MEASUREMENT OF BRITISH VESSELS.

PRELIMINARY.

1. *Authority for instructions.*—These instructions are issued by the Board of Trade under the provisions of the Merchant Shipping Acts for the assistance and guidance of their officers in measuring the tonnage of ships.

2. *Fees and expenses.*—Instructions as to the fees and expenses payable in connection with tonnage measurement are contained in the pamphlet entitled "List of fees and expenses payable in connection with Board of Trade surveys."

3. *Law relating to tonnage.*—The tonnage regulations of the Merchant Shipping Acts, 1894 to 1907, are inserted in Appendix 3, page 271, and the surveyors are expected to make themselves thoroughly conversant therewith, and also with the following instructions regarding their application. Whenever in the course of these instructions reference is made to "the act" or to a section or schedule by number only, the reference is to the Merchant Shipping Act, 1894.

4. *Surveyors to refer to principal surveyor for tonnage.*—The measuring surveyor will in all cases obey and be immediately responsible to the principal surveyor for tonnage with regard to these instructions, and when in doubt upon any point he should refer it to him for direction, and the principal surveyor will, if necessary, submit it for the consideration and decision of the Board of Trade.

5. *Gross and net tonnage.*—For the purpose of the tonnage regulations of the Merchant Shipping Acts, the ton is a unit of volume containing 100 cubic feet. The act provides that

for the purpose of ascertaining the register or net tonnage of a ship, the gross tonnage shall first be ascertained in accordance with the directions contained in the second schedule, and the deductions provided for in the acts shall then be made from the gross tonnage so ascertained.

GROSS TONNAGE.

6. *Items of gross tonnage.*—The gross tonnage consists of the sum of the following items:

(*a*) The cubical capacity of the vessel below the tonnage deck;

(*b*) The cubical capacity of each space between decks above the tonnage deck;

(*c*) The cubical capacity of the permanent closed-in spaces on the upper deck available for cargo or stores or for the berthing or accommodation of passengers or crew; and

(*d*) The "excess of hatchways."

7. *Application of Rules I and II, respectively.*—The act provides that the gross tonnage must always be ascertained by Rule I in the second schedule, except in the case of ships which requiring to be measured for any purpose other than registry have cargo on board, and ships which requiring to be measured for the purpose of registry, can not be measured by Rule I, in which cases Rule II may be employed. The surveyors should note, however, that Rule II is not to be adopted in any case without the special sanction of the Board of Trade, except in the case of pleasure yachts under 50 feet in length, which may be measured for registry under Rule II without special authority if the application of Rule I is impossible owing to some or all of the fittings of the vessel being in place at the time of measurement.

Any ship which has been measured under Rule II may at any subsequent period be re-measured under Rule I on the application of the owner, and the payment of the prescribed fees.

MEASUREMENT UNDER RULE I.

SPACE BENEATH THE TONNAGE DECK.

8. *Definition of tonnage deck.*—The tonnage deck is the upper deck in all ships which have less than three decks, and the second deck from below in all other ships; but the protective deck of a warship is not to be considered as a deck within the the meaning of section 77 (6).

9. *Modification of rules for vessels with double bottoms.*—The rules for measurement under the tonnage deck are contained in paragraphs (1) to (3) of Rule I, but in the application of these rules to vessels with double bottoms for water ballast regard must be had to the provisions of section 81 in respect of the depth measurements in every case. In the case of vessels in which the double bottoms are designed with a rise transversely, regard must also be had to the modifications made by the Board of Trade under section 77 (7) to meet such cases in respect of the position and number of breadths to be measured, and the mode of computing the areas. The rules as modified under these sections are printed on pages 276 to 278, and must be followed in all cases so far as they apply.

10. *Measurement to be made at an early stage.*—In order that the measurement of the gross tonnage may be effected under proper conditions, the surveyors should watch the progress of the building of all steam vessels within the limits of their port, so that the measurements may be taken when the hold is ready and while it is still sufficiently clear for the purpose. At the same time, it will be understood that the responsibility for applying for measurement rests with the builders or owners, as the case may be.

11. It is of great importance, not only that the rules given by the act should be followed, but that all the required measurements should be taken, and the calculations made, in one uniform and correct manner, so that one general system may prevail in this respect throughout the various ports of the Kingdom. For this purpose the following practical directions are given, showing the several progressive steps, briefly stated, to be observed in the practical operation of measurement by Rule I.

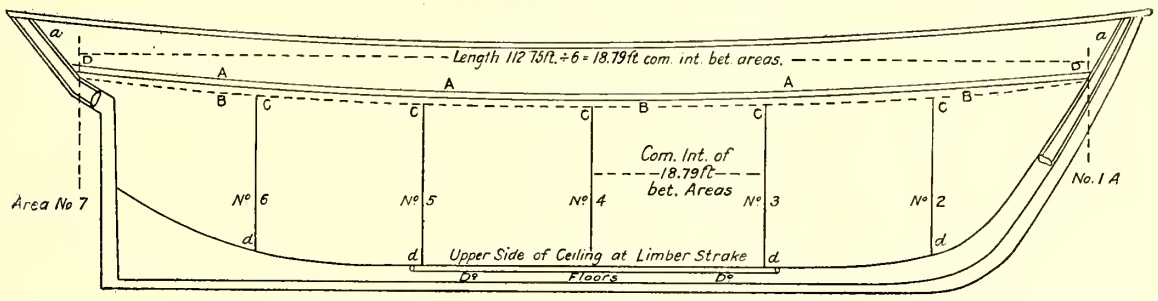
The measurements made at the ship may be recorded in the notebook provided for the purpose (form surveys 58A), and they are subsequently to be entered in the printed formula appropriate to the case. (See par. 42, and p. 299.)

12. *Length.*—The length at the tonnage deck, in all vessels of the usual sheer [1], is to be taken on the upper surface of the deck, at such a parallel distance from the middle line of the ship as to clear the several hatchways and other obstacles that may present themselves. Having fixed upon the ends of this parallel line as far, both forward and aft, as may be found convenient, mark them on the deck, and square them into the middle line of the ship; then take the distances from the points thus determined on the middle line to the inside of the plank at the bow and stern, respectively, or to the inside of the angle irons or frames in iron or steel ships if not ceiled at bow and stern, making the requisite deductions for the rakes of the bow and stern, as set forth in the rule, and as shown in figure 1; the sum of these two distances, added to the length of the parallel line marked on the deck as aforesaid, gives the whole length required.

13. *Points of division of the length or stations of the transverse areas.*—Having divided the length into the number of equal parts required by the rule, set off the points of division by mark-

FIGURE I.—Showing the length of a vessel at the tonnage deck, its points of division for the stations of the areas, and the depth at each area, as measured under Rule I (1).

[The diagram, being merely descriptive, is not drawn to scale.]



References:

A, A, A represents the upper side of the tonnage deck.

B, B, B (plain line), the under side of deck or beam line.

a, *a* represents the inside plank or lining at bow and stern.

D, D (dotted line), the length, taken on the upper side of the deck from plank to plank, showing the deduction at each end (namely, the distance from the inside plank to the upright dotted line at D), as prescribed by the rule, on account of the rakes of the bow and stern. These deductions are necessary in consequence of the length being taken above its right position; the right position being at the head or top of the areas, shown by the dotted line passing through the points C, C, etc., at one-third of the round of the beam below the deck line.

The length, being in this case 112.75 feet, is divided into six equal parts, giving the stations of the areas, with the common interval of 18.79 feet between them.

C*d*, C*d*, etc., represent the stations and depths of the areas of the five points of division.

C, C, C, etc., show the upper points of the depths at one-third of the round of the beam below the deck or beam line.

d, *d*, *d*, etc., show the lower points of the depths, at the upper side of the ceiling at the inside of the limber strake.

ing their places on the tonnage deck with a piece of chalk (thus showing the positions of the different transverse areas on the tonnage deck), and number them successively 1, 2, 3, 4, etc., No. 1 being at the extreme point of the length at the bow, No. 2 at the first point of division just marked on the deck, and so on successively, the last number being at the extreme point of the lngth at the stern. (See Fig. I.)

14. The *positions* at which the *areas* have to be taken are next to be transferred from the deck to the keelson in the hold, and for this purpose a line is to be extended down the main hatchway in a direction perpendicular to the keel, by means of a square placed on the upper side of the keelson; the distance of the midship area from this line at the tonnage deck is then to be set off from the point thus determined on the keelson, which gives the station of the midship area on the keelson; and the stations of the others are obtained on the keelson by setting

[1] It is found that the length taken on the surface or sheer line of the deck, in vessels of the usual sheer, is as eligible for the practical purposes of tonnage as when taken on the perfect straight line or chord of the sheer; for the difference in the two lengths thus taken, in the case of a vessel having more than the usual sheer of 3 feet in 250, amounts to about 2½ inches, giving a difference in the tonnage of only about one-tenth per cent.

But in the case of the Dutch galiots, or doggers, as they are termed, which have a depth of sheer of about 5 feet in 100, the difference in the two lengths amounts to about 11 inches, giving an increase of about 1 per cent in the tonnage due to the increased length. Therefore, in all such cases of unusually large sheer, the length for computation must be taken by means of a tape or line stretched tightly from end to end of the deck.

off, afore and abaft the midship one, the common interval between them, as already marked off on the tonnage deck.

15. *Round of beam.*—The round up or spring of the beam, which must be known before taking the exact length of the vessel, as well as before measuring the depths of the areas, may be taken either at the underside of the deck, by stretching a small line tightly from end to end of the beam, which will show the round or spring of the beam at the center; or it may be taken, if more convenient, at the upper side of the deck, by stretching a line tightly across, held at equal heights from the deck at each side of the ship, so as just to touch the crown of the deck at the middle line; then the distance from the deck to the line at the ship's sides gives the round up or spring of the beam. It is necessary to take the round of beam at each point of division of the length except when the vessel has a parallel or nearly parallel breadth.

16. *Measurement of transverse areas.*—In the case of steam vessels which at the time of measurement have their machinery fitted, and in which the prescribed transverse sections or areas falling in the engine room can not be measured, other areas are to be measured in places which are clear in lieu of such as are obstructed, and as near to them as possible, the new positions being noted in the surveyor's formula accordingly.

The whole of the areas are then to be computed by the surveyor in the prescribed manner.

The extreme points of the length at the bow and stern, though described as being the positions of the first and last areas, do not, in vessels of usual form, yield any area, as the vertical transverse section at each of those places vanishes into a mere horizontal line. Therefore, in the computation for tonnage, where the first and last areas form part of the process, a cipher must be employed in their places. But in vessels of unusual form, as, for instance, in barges or other craft in which the bow and stern are upright, with breadth also at those places, the extreme points of the length will yield areas; in which cases such areas must be measured and used in the computation as the rule directs.

17. *Depths.*—The depth of the midship area is to be taken from the underside of the tonnage deck to the upper side of the floor timber at the inside of the limber strake, placing the measuring staff parallel to the middle plane of the ship, and also square to the keel by means of a square placed on the upper side of the keelson. From the depth thus ascertained is to be deducted one-third of the round of the beam, and also the average thickness of the ceiling on the floor timber. (See Fig. II, p. 287.)

The depths at the other areas are to be taken in the same manner, taking care, where the keelson curves upward, to place the measuring staff square to the line in continuation of the upper side of the keelson in midships.

In vessels with a raised platform in the bottom, and no ceiling fitted, the depths are to be taken down through the platform to the upper side of the usual floor timbers, deducting therefrom the thickness of the platform in question.

18. If the vessel has a double bottom for water ballast, the depths are to be taken to the upper side of the inner plating of the double bottom, which is deemed to represent the floor timber, provided the surveyor can certify that the space between the inner and outer plating is not available for the carriage of cargo, stores, or fuel. This question will not, however, arise as a rule in the case of double bottoms for water ballast constructed on the cellular principle where the floors extend the full depth of the space; but as regards double bottoms other than those of cellular construction the surveyors must satisfy themselves that the requirements of section 81 are compiled with.

19. The division of the depth into four, five, six, or seven equal parts, as the case requires, and subdivision of the lowest part into four equal parts, which is necessary when the depth is divided into five or seven equal parts, gives the points of division at which the intermediate breadths between the upper and lower ones are to be taken.

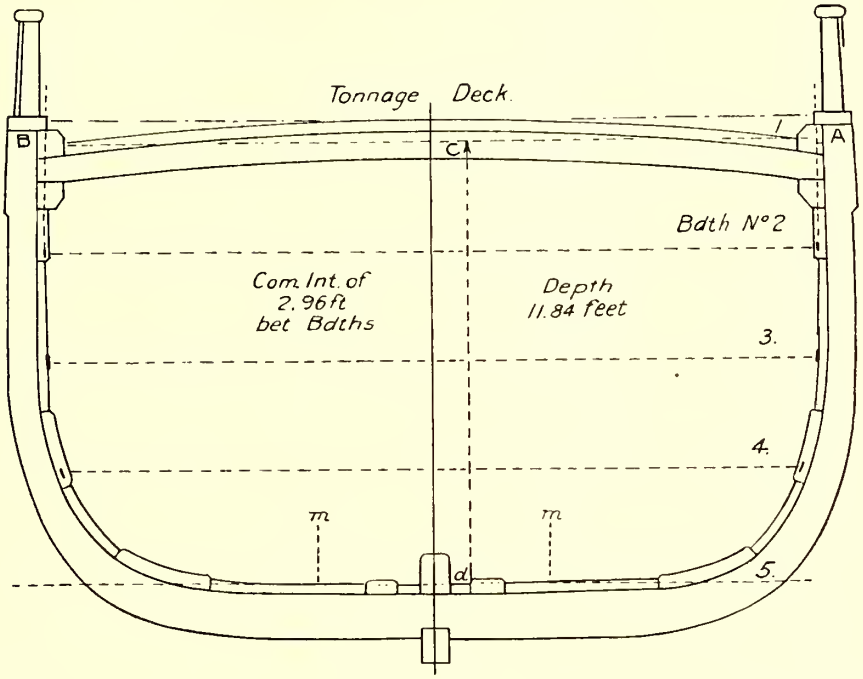
When the underdeck tonnage is measured in parts in consequence of a break or breaks in the double bottom, the tonnage depth at the middle of the tonnage length will determine the number of parts into which all the remaining tonnage depths are to be divided.

20. *Breadths.*—The depth at any area being ascertained as above directed, and divided into the required number of equal parts, the points of division at which the breadths are to be taken are to be marked on the staff; and the staff being refixed in its original position, the breadths of the areas are then to be taken by extending a staff or tape *horizontally athwart* through each point, from plank to plank, to its average thickness between the respective points of measurement. (See Fig. II.)

In the case of iron or steel vessels of the usual construction having no ceiling on the sides, the breadths are to be taken to the inner edge of the angle irons or frames.

21. In the case of batten or spar ceiling, the spacing being not more than about 1 foot, the breadths are to be taken to the face of the battens or bars, as the case may be. If, however, the battens or bars are more than 1 foot apart, the breadths must be taken to the average thickness

FIGURE II.—Illustrating the measurement of the midship area, under Rule I (2).



References to Figure II.

Cd represents the depth, the upper point C of which is at one-third of the round of the beam from the beam line and the lower point *d* at the upper side of the ceiling at the inside of the limber strake.

This midship depth, being under 16 feet, is divided into 4 equal parts, giving the position of the breadths at 2.96 feet apart.

A, B represents the upper breadth passing through the point C, which is the upper boundary of the area.

m, *m* represents the lower breadth taken horizontally through the point *d*.

between the respective points of measurements. When spar ceiling is fitted of a greater thickness than 3 inches, this dimension is to be regarded as the maximum for which allowance is to be made when measuring the horizontal breadths, but when the thickness is less than this, the actual thickness only is to be allowed.

22. When the holds are insulated for refrigerating purposes, and the casing extends beyond the edges of the frames or above the top of the floors or double bottom, a maximum allowance of 3 inches may be made when measuring the horizontal breadths and also the depths of areas; but if the projection is less than 3 inches, only the actual projection is to be allowed.

23. *Upper breadth.*—On referring to Figure II below, it will be observed that, as the horizontal direction of the upper breadth passes through the deck, it can not be taken when the deck is laid, and therefore must be measured on the upper side of the deck, as shown by the

upper dotted line, allowing within the rough-tree timbers the thickness of the ceiling between decks below, as shown by the figure.

By this method the upper breadth is taken from 4 to 6 inches above its proper position (as seen by inspection of the figure); and, in vessels which have upright sides, this will be perfectly correct; but in the case of inclining sides, the necessary allowance must be made for the deviation of the sides from the upright in the 4 or 6 inches additional height, as aforesaid.

In the case of three-deck ships, the upper breadth of each transverse section is to be taken on the tonnage deck from side to side, allowing for the average thickness of plank or spar ceiling, as the case may be.

24. *Lowest breadth.*—It is manifest also from the figure that the lowest breadth, when the vessel has no horizontal flat or floor, is limited to the distance between the two limber strakes; and that, in flat-floored vessels, it is bounded by the extent of the horizontal flatness of the vessel, as shown in the figure between the points *m*, *m*.

25. In setting down the breadths of the areas according to their progressive numbers in the proper column in the formula, it should be noted that breadth No. 1 is that at the upper point of the depth.

26. In all cases the appropriate formula according to the length and depth of the vessel is to be used for computing the under-deck tonnage. A list of formulæ is given on page 299 of these instructions. The form surveys 50A is used as a supplement to the ordinary formula in large vessels when room can not be found on the ordinary formula for entering the full details and computations of spaces above deck, exempted spaces, engine room, etc.

27. The following epitome of the directions for under-deck measurement contained in Rule I may be found useful:

Length.—Taken inside on tonnage deck (*i. e.*, the upper deck in vessels having less than three decks, and the second deck from below in all other vessels) from inside of plank at stem to inside of midship stern timber or plank there (as the case may be); the length so taken, allowing for rake of bow in thickness of the deck, and for rake of stern in the thickness of the deck and one-third of round of beam, is to be divided into the prescribed number of equal parts (thus determining the stations of the areas), according to the length, as follows:

Class 1. Length of 50 feet and under, into 4 equal parts.

Class 2. Length above 50 to 120 feet, into 6 equal parts.

Class 3. Length above 120 to 180 feet, into 8 equal parts.

Class 4. Length above 180 to 225 feet, into 10 equal parts.

Class 5. Length of 225 feet and upward, into 12 equal parts.

Areas.—Area No. 1 is at the extreme limit of the bow. Area No. 2 is at the first point of division of the length. The rest are numbered in succession, the last being at the extreme limit of the stern.

Depths.—Taken at each point of division of the length or station of each area, from the under side of tonnage deck to ceiling at inner edge of limber strake, deducting therefrom one-third of the round of the beam; the depths so taken are to be divided into four equal parts, if midship depth does not exceed 16 feet, otherwise into six equal parts. But if the vessel has a double bottom for water ballast and the surveyor can certify it as not available for cargo, stores, or fuel, and if the inner bottom has a rise transversely, then the depths are to be divided into five or seven equal parts, as the case requires, instead of four or six, and the lower part is to be subdivided into four equal parts.

Breadths.—Taken at each point of division of the depths, and also at the upper and lower points of the depths. The upper breadth of each area is to be set down as No. 1 in its respective column in the formula, and the rest in succession.

Where breaks in the double bottom exist and the vessel is measured in parts, lengths of 30 feet and under are to be divided by 2.

MEASUREMENT OF SPACES BETWEEN DECKS.

28. The *spaces between decks* above the tonnage deck, in the case of ships of three or more decks, are to be measured and added to the underdeck tonnage. The directions for the measurement of these spaces are so fully detailed in Rule I (4) as to require no notice here. (See paragraph 41 as to the measurement of 'tween deck spaces in round-sterned ships.)

EXCESS OF HATCHWAYS.

29. In all new vessels, and in all vessels coming in for remeasurement, the cubical contents of the hatchways are to be obtained thus: Multiply the length and breadth together and the product by the mean depth taken from the top of beam to the underside of the hatch. From the aggregate tonnage of the hatchways deduct one-half per cent of the gross tonnage, and add the remainder to the gross tonnage of the ship.

MEASUREMENT OF SPACES ON THE UPPER DECK.

30. The act provides that if there be a break, poop, or any other permanent closed-in space on the upper deck available for cargo or stores, or for the berthing or accommodation of passengers or crew, it must be measured and included in the gross tonnage.

31. In carrying out this direction, and deciding whether or not deck erections should be measured and added to the tonnage, the surveyor should have regard to the character and structural condition of such erections at the time when they are presented to his notice.

32. Poops, bridges, or any other permanent erections with one or more openings in the sides or ends not fitted with doors or other permanently attached means of closing, but otherwise so closed in as to be not only available but also actually fitted and used for the berthing or accommodation of passengers, must be measured and added to the tonnage.

33. Subject to the foregoing exception, poops, bridges, or any other permanent erections with one or more openings in the sides or ends not fitted with doors or other permanently attached means of closing them, should not be measured and included in the tonnage. Whenever any portion of such erection is occupied by timber, stores, or other goods, the tonnage of such space is ascertained and recorded by the officers of customs and excise in accordance with section 85.

34. The minimum width and height of the permanent openings in the bulkheads is fixed at 3 feet and 4 feet, respectively, and if coamings are fitted thereto their height must not exceed 2 feet.

A single opening at one side of a bulkhead is not considered sufficient to entitle the space thus partitioned off to exemption, unless, in addition to this, there are a number of freeing ports and scuppers fitted on each side of the space claimed. In such cases the owner's application for exemption and also a sketch of the space drawn to scale must be forwarded to the principal surveyor for tonnage for examination, and exemption must not be allowed without the board's approval.

35. *Shelter-deck spaces.*—When exemption from measurement is claimed for the space between the upper and shelter decks on the ground of a permanent middle line opening in the shelter deck, the length of this opening must not be less than 4 feet clear, and the width must at least be equal to that of the after-cargo hatch upon the same deck. The distance between the after edge of the deck opening and the aft side of the sternpost must not be less than one-twentieth the registered length of the vessel, or if the opening is placed forward the foreside must not be less than one-fifth the length of the vessel from the stem. When the permanent deck opening is situated aft, there must be at least two openings in all the transverse bulkheads in the 'tween decks on the foreside of it to entitle the space to exemption, and these openings must comply as regards dimensions and size of coamings (if any) with the requirements of paragraph 34 above.

There must also be on each side at least one freeing port of good size abreast the deck opening, and a suitable number of scuppers not less than 3½ inches diameter distributed throughout the space.

The coamings to the deck opening must not exceed 12 inches mean height above the deck, and the opening must be fenced with guard rails and stanchions, the latter being so fitted as not to lend themselves to battening down the opening.

If portable wood covers are fitted the lashings beneath for holding them down are to be of hemp.

All openings in the upper deck must be provided with proper means for closing and battening down.

36. The tonnage measurement of all spaces above the upper deck that the surveyor has *not* included in the gross tonnage of the vessel should be given in detail on the formula, which, when forwarded to the tonnage office for test and examination, should be accompanied by any plans, sketches (drawn to scale), or explanation required for the proper consideration of the exemption of such spaces.

Should there be no spaces above the upper deck which have been exempted, this should be noted on the formula.

The surveyor should be careful to record in the space provided on the certificate of survey, form surveys 59, the principal dimensions, tonnage, and position of all spaces above the upper deck that are not included in the cubical contents forming the ship's registered tonnage.

37. *Shelter for deck passengers.*—The act provides that no addition shall be made to the tonnage in respect of any building erected on the upper deck for the shelter of deck passengers and approved by the Board of Trade. When application is made, or when the surveyors think there is a claim for the exemption of any such space fitted for the shelter of *deck passengers* on short voyages, who would otherwise be exposed to spray and shipment of seas, and other inclemencies of the weather, the surveyors should apply to the board, through the principal surveyor for tonnage, for directions, describing the erection and how it is secured, with any particulars they think necessary. A scale drawing showing the space or spaces and indicating the water-closet arrangements for the men and women, respectively, should always accompany the application.

38. *Closed-in spaces which may be exempted.*—The following *exceptions* to the general rule of measuring all closed-in or weather-protected spaces are allowed:

(*a*) Any closed-in space or spaces solely appropriated to and fitted with machinery.

(*b*) The wheel-house for sheltering the man or men at the wheel.

(*c*) The cook-house and also the bakeries when fitted with ovens and used entirely for such purposes.

(*d*) The condenser space.

Provided always that the spaces are no larger than required for the purposes mentioned.

(*e*) *Water-closets or privies* for the officers and crew; and in the case of vessels fitted particularly for passengers, an additional one may be allowed for every 50 persons; not more than 12 are, however, generally necessary.

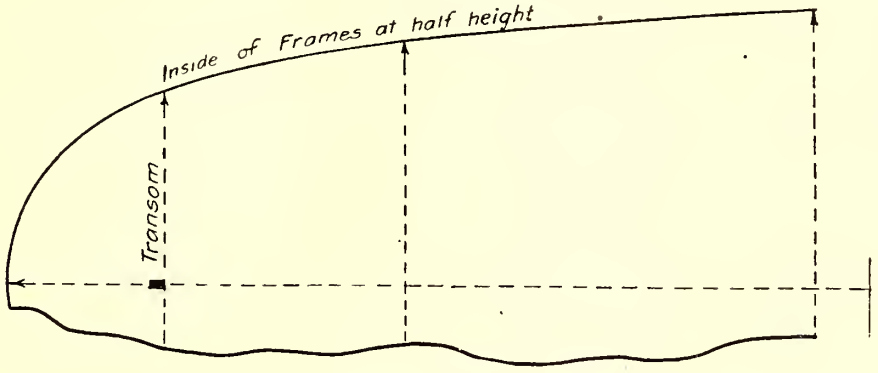
39. *Method of measuring erections.*—Rule I (5) contains full directions for ascertaining the cubic capacity of such spaces above deck as, in accordance with the act and the above instructions, are required to be measured and added to the tonnage; and the only points that seem to require special notice are those dealt with in the following two paragraphs.

40. *Break.*—A break is the space above the line of upper deck when the deck is cut off and continued at a higher elevation. The height of a break is the distance from the under side of the upper deck to the under side of the break deck.

41. *Round-sterned ships.*—The after breadth of a break, poop, or space in upper 'tween decks of similar form, should as a rule be measured in iron and steel ships at the transom plate connected with the rudder post, and in wood ships at a corresponding position. The breadth should be measured at the middle of the height of the space. (See Fig. III., p. 291.)

If, however, there are any special features in the design of the vessel which may suggest the desirability of a modification of this rule, full particulars of the case should be forwarded to the principal surveyor for tonnage for consideration accompanied with scale drawings relating to the question.

FIGURE III.



42. *Worked example of measurement under Rule 1.*—The following example shows the application of Rule I to a vessel remarkably sharp at the bow and stern, and very full amidships. It also shows the method of filling up and using the formula referred to in paragraph 11.

The length of the vessel is supposed to be 112.75 feet, and this being between 50 and 120 feet must be divided by 6 to find the common interval between areas, viz, $112.75 \div 6 = 18.792$ feet.

That part of the formula relating to the computation of the areas is then filled up as follows:

		Area 1.		Area 2.		Area 3.		Area 4.		Area 5.		Area 6.		Area 7.	
Depths		Feet.		Feet. 12.65.		Feet. 12.3.		Feet. 11.85.		Feet. 11.4.		Feet. 10.9.		Feet.	
Com. inter. between breadths		.....		3.162.		3.075.		2.962.		2.85.		2.725.		.....	
No. of bths.	Multipliers.	Bths. ft.	Products.	Bths. ft.	Products.	Bths. ft.	Products.	Bths. ft.	Products.	Bths. ft.	Products.	Bths. ft.	Products.	Bths. ft.	Products.
1	1	.....	.....	19.35	19.35	20.2	20.2	20.4	20.4	20.2	20.2	19.1	19.1	.....	.....
2	4	.....	.....	18.85	75.4	20.4	81.6	20.5	82	20.35	81.4	18.65	74.6	.....	.....
3	2	.....	.....	16.65	33.3	20.15	40.3	20.25	40.5	20	40	14.95	29.9	.....	.....
4	4	.....	.....	11.85	47.4	19.6	78.4	19.85	79.4	17.8	71.2	8.75	35.0	.....	.....
5	1	.....	.....	1.85	1.85	3	3	6.35	6.35	6.35	6.35	1	1	.....	.....
$\frac{1}{3}$ of com. inter. betw. bths..		.....			177.3 1.05		223.5 [1] 1.03		228.65 .99		219.15 .95		159.6 .91	.....	
		0			186.165		230.205		226.363		208.192		145.236	0	
		Ar. 1.		Ar. 2.		Ar. 3.		Ar. 4.		Ar. 5.		Ar. 6.		Ar. 7.	

[1] See paragraph 95.

The areas thus ascertained are next inserted in the column of the formula headed "Cubic content and register tonnage," and the under deck tonnage is thus ascertained.

No. of areas.	Multipliers.	Areas.	Products.
1	1	0	0
2	4	186.17	744.68
3	2	230.21	460.42
4	4	226.36	905.44
5	2	208.19	416.38
6	4	145.24	580.96
7	1	0	0
			3107.88
½ com. inter. between areas			6.26
			19455.32
Under-deck tonnage			194.55

The tonnage of the closed-in space on deck (in this case a break) is then ascertained, the column headed "Closed-in space" being filled up as follows:

Mean length 32.15 feet.			
Com. inter. between breadths 16.075 feet.			
No. of breadths.	Multipliers.	Breadths (feet).	Products.
1	1	20.	20.
2	4	18.6	74.4
3	1	17.15	17.15
			111.55
⅓ com inter. between breadths			[1] 5.36
			597.91
Height			2.
			1195.82 cubic feet.
			11.96 tons.

[1] See paragraph 95.

The tonnage of the break being added to the under-deck tonnage gives the gross tonnage. The gross tonnage is therefore:

194. 55 under deck.
11. 96 break of deck.

206. 51 gross tonnage.

MEASUREMENT UNDER RULE II.

43. *Alteration of factors.*—It should be noted that the decimal factors of tonnage originally prescribed by this rule, as given in the act, have been altered, under the provisions of section 77 (7), to .0017 for ships built of wood, and .0018 for those built of iron.[1]

44. *Tonnage deck.*—For the purpose of measurement by Rule II, the upper deck is always the tonnage deck, whatever may be the number of decks, so that the tonnage of the 'tween decks, which has to be measured separately under Rule I, is measured and included in the first operation of Rule II by girting, and separate measurement of the 'tween decks is unnecessary.

[1] See Customs General Order No. 72 of 1858.

45. *Tables for reference.*—In measuring the length of wooden vessels under Rule II, the following tables may be found useful:

(*a*) *Usual thickness of the side or shells of vessels at the upper deck.*

Tonnage.....	50	150	250	350	500	700	1,000	1,500
Whole thickness at upper deck..	*Ins.* 8½	*Ins.* 10½	*Ins.* 12¼	*Ins.* 12¾	*Ins.* 13½	*Ins.* 14½	*Ins.* 15¼	*Ins.* 15½

(*b*) *Usual distance between the after side of the sternpost and its rabbet at the wing transom, or if there is no wing transom, at the point where the counter plank meets or crosses the rabbet.*

Tonnage.....	50	150	250	350	500	700	1,000	1,500
Distance between aft side of post and its rabbet at the wing transom..	*Ins.* 8	*Ins.* 10	*Ins.* 12	*Ins.* 14	*Ins.* 16	*Ins.* 18	*Ins.* 19	*Ins.* 21

46. *Spaces on deck.*—It will be observed that in Rule II, as in the case of Rule I, all *closed-in spaces* on the upper deck are to be measured, but in a more summary manner than is directed by Rule I, and in determining what spaces are to be measured the surveyors should be guided by paragraphs 30 to 38 above.

47. The hatchways are to be dealt with as directed in paragraph 29 above.

48. *Example of Rule II.*—The following example shows the application of Rule II to a vessel remarkably sharp at the bow and stern and very full amidships. The vessel is the same as the one referred to in the worked example of Rule I, given in paragraph 42, and the surveyors should note the difference which may arise between Rules I and II in a vessel of such unusual shape.

Ft.
44 main girth under keel from deck to deck at ship's sides.
22. 7 main breadth.

2)66. 7

33. 35 squared is 1, 112. 22
109 length as prescribed by act.

[1] 121, 231. 98
. 0017 factor for wooden vessels.

206. 0927 tons under deck.
11. 93 tons of break of deck, as below.

218. 02 gross tonnage.

Break of deck.

Lgth.		Bdth.		Ht.		Cub. ft.		Tons.
32.15	×	18.55	×	2	=	1,192.76	÷ 100 =	11.93

[1] As the decimals in this multiplicand are never of any value as regards the resulting product, they may be discarded.

REGISTER TONNAGE.

49. The surveyors should note the following instructions relating to the various deductions made from the gross tonnage in order to ascertain the register or net tonnage.

ALLOWANCE FOR PROPELLING POWER.

50. *Engine room always to be measured.*—Notwithstanding the ratable allowance for propelling power for which the act provides, the surveyors will observe that it will always be necessary to measure the engine room, whatever may be its size, in order to ascertain whether the allowance to be deducted for the propelling power is to be regulated by the general percentages prescribed by the act, or by the actual contents of the engine room, ascertained by measurement.

51. *Items of engine-room tonnage.*—The tonnage of the engine room may include the following items under section 78:

(*a*) Space below the crown of the engine room;

(*b*) Space between the crown and the upper deck framed in for the machinery or for the admission of light and air;

(*c*) Space similarly framed in above the upper deck; and

(*d*) The contents of the shaft trunk or trunks in screw vessels.

52. *Directions for measurement.*—The measurement of the engine-room space is to be made in accordance with Rule III in the second schedule.

SPACE BENEATH THE CROWN.

53. *Meaning of "crown."*—The crown or top of the main space of the actual engine room, from which the depth of the main space is to be taken, will either be at the underside of a deck or, if the side bulkheads are curved, at the point or height at which the curve terminates.

54. *Measurement in parts.*—In the case of engine rooms of irregular form, the space is to be measured in parts with a view to obtaining the correct cubic contents.

55. *Length.*—As regards the length of the actual engine room, that length only is to be measured which is requisite for containing the boilers and machinery, with the addition, when the fire grates are in a fore and aft direction, of such length as is necessary for the stoking or working of the fires in a fore and aft direction clear of the machinery. The additional length on this account may be about 1 foot more than the length of the fire grates. This length will be found, generally speaking, to be from about 5 feet to 9 feet, and in any case where it may appear to the surveyor that a greater length should be allowed, he must submit all particulars, with plans, to the principal surveyor for tonnage for consideration.

No such additional length is, however, required when the boilers are placed with the fire grates athwartships, as in such a case the stoking or working of the fires in an athwartship direction does not interfere with the position of the engines. The clear central space required between the boilers when the stoking is athwartships is from about 8 to 11 feet. The point to which the after boundary of the length of the engine room is to be measured should be no farther aft of the after cylinder, or of its valve casing, than is necessary for safe working; but in no case without special instructions should the actual point of measurement be more than 4 feet from such cylinder or valve casing.

With regard to the length to be allowed between the engines and boilers, the surveyor should in no case allow more than may appear to him necessary for the safe working of the machinery.

56. The restrictions of the main engine and boiler space referred to in the foregoing paragraph are not to be applied to trawlers, tugs, or yachts, nor to the ordinary screw or paddle steamers obtaining the allowance of 32 or 37 per cent of the gross tonnage respectively.

If in any other case a departure from either of the above rules as to length appears to be necessary, owing to the high power of the engines, or to any peculiarity in the arrangement of the machinery, the surveyor should, before fixing the length to be allowed, forward all particulars with plans to the principal surveyor for tonnage for consideration.

57. *Form surveys 128.*—Particulars of the engine and boiler space should be recorded on the form surveys 128, which should be attached to the formula when the latter is submitted with the engine spaces inserted.

SPACES BETWEEN CROWN AND UPPER DECK.

58. The engine spaces between the crown and the upper deck, if any, are to be measured separately, and their cubical contents added to the main space.

SPACES ABOVE THE UPPER DECK.

59. On the request of the owner in writing, engine spaces above the upper deck may be measured under section 78 (2) and their contents added to the gross tonnage, as well as to the actual engine room, if they are (*a*) reasonable in extent, (*b*) safe and seaworthy, and (*c*) so constructed that they can not be used for any purpose other than the machinery, or for admission of light and air to the machinery and boilers of the ship. In dealing with these cases the surveyor should in each instance submit a detailed description and measurement of the spaces and a form surveys 117, together with sketches or tracings, to the principal surveyor for tonnage, and should not in any case complete the measurement until he receives instructions in respect thereof. In construing the words "reasonable in extent" the surveyor should note that—

(i) The length should not exceed the length of the propelling space, and if any portion is plated over, the length of the plated part should be deducted from the full length; and

(ii) Whatever the breadth of the casing may be, no greater breadth is to be allowed for the purpose of propelling space deduction than one-half the extreme inside breadth of the ship amidships.

These erections have in the past in some cases greatly exceeded all reasonable requirements for the admission of light and air. The surveyor should be careful to report whether the extra erections are necessary at all, and whether light and air could not be safely admitted to the engine space and boiler space without these erections being carried up above the "crown," and, if such is the case, he should not regard them as "reasonable in extent" within the meaning of this section, and should not allow their contents to contribute to the deductions from gross tonnage.

The surveyor will say in his report whether, in his judgment, the spaces are safe and seaworthy, but if in any case he has any doubt on these points he should state it in his report on form surveys 117.

When approved, each such space must be permanently marked on the inside thereof, "certified as part of the engine room."

SHAFT TRUNKS.

60. When there is no built tunnel, the following rules should be observed in the case of a vessel with a single screw. The thrust block space should be taken of such length and breadth as will admit of a man getting round it to remove the holding-down nut, and the height need not exceed 7 feet. The tunnel allowed should be of ordinary dimensions suitable for the vessel.

When the vessel is a twin screw, and the space aft of the engines is open from side to side, the space should not be included in the engine-room measurement for a greater height than 6 feet mean, and any space therein appropriated for stores, or for any purpose other than the propelling power, should be deducted from the space to be included in the engine room.

61. *Escape ladderways from trunk shaft.*—When a trunked ladderway is fitted from the deck to the after part of the shaft trunk, the trunkway is to be measured and its cubical capacity included with that of the shaft trunk in estimating the allowance for propelling power, provided that it is no larger than is necessary for the purposes of access to and escape from the tunnel.

62. *Spaces not to be included.*—The cubical contents of the engine space having been ascertained as described above, the cubical capacity of any cabins or storerooms which may be fitted in the engine room, and also any space occupied by, and necessary for, the safe working of machinery not used in propelling the ship, must be deducted, and the remainder being divided by 100 will be the net tonnage of the actual engine room.

63. *Mode of calculating allowance for propelling power.*—The net tonnage of the actual engine room having been ascertained according to the rules in the act, and to the foregoing directions, the method of estimating the allowance to be deducted for the propelling power under section 78 (1) and the act of 1907 remains to be considered; and in proceeding to ascertain this allowance the following are the principal points for the measurer to consider.

64. *Engine rooms of usual size.*—When the tonnage of the actual engine room, as above ascertained, amounts, in the case of paddle vessels, to between 20 and 30 per cent, and in the case of screw vessels to between 13 and 20 per cent of the gross tonnage of the vessel, the allowance is to be, in the case of paddle vessels, 37 per cent ($\frac{37}{100}$), and in the case of screw vessels 32 per cent ($\frac{32}{100}$), of such gross tonnage.

If the tonnage of the actual engine room does not lie between the above-mentioned limits for paddle and screw steamers respectively, the act provides that the allowance for propelling power may be calculated in the same manner, or as an alternative the Board of Trade or the owners may require the allowance to consist of $1\frac{1}{2}$ times the tonnage of the actual engine room in paddle vessels and $1\frac{3}{4}$ times the tonnage of the actual engine room in screw vessels.

65. *Small engine rooms.*—In all cases where the actual engine room is not greater than 20 per cent, or 13 per cent of the gross tonnage, according as the vessel is a paddle or a screw steamer, the board requires the last-mentioned scale to be adopted, unless express directions to the contrary are given in any particular case.

66. *Large engine rooms.*—If the tonnage of the actual engine room is not less than 30 per cent, or 20 per cent of the gross tonnage, according as the vessel is a paddle or a screw steamer, the allowance is to be calculated in the manner explained in the first part of paragraph 64 above, unless the owner exercises his option of having it calculated by the alternative method explained in paragraph 65, in which case the provisions of the Merchant Shipping Act, 1907, must be taken into consideration.

67. *Restriction on allowance for propelling power.*—The Merchant Shipping Act, 1907, provides that in all steamships, except tugs exclusively used in towing, the deduction for propelling power is not to exceed 55 per cent of that portion of the tonnage which remains after deducting from the gross tonnage any crew space and other deductions allowed under section 79 of the Merchant Shipping Act, 1894, and when preparing the tonnage formula the surveyor should be careful that the deduction to be allowed does not exceed this limit.

It should be carefully noted, however, that the act does not come into operation until January 1, 1914, in the case of ships either contracted for, commenced, or built before May 1, 1907.

Whenever a tonnage formula is forwarded for a new steamship intended to be employed as a tug, the surveyor should also furnish a report stating whether or not the vessel is to have a passenger certificate or is to be used for the carriage of cargoes, as it is only in tugs constructed and used *exclusively for towing* that the 55 per cent limit for propelling space deduction is not to be applied.

The surveyor should note that the foregoing instruction does not supersede any of the provisions of Rule III or of paragraphs 50 to 62 of these instructions.

68. *Worked example.*—The following worked example shows the calculation of the allowance for propelling power in the case of the vessel referred to in paragraph 42 above:

EXAMPLE OF CALCULATION FOR ENGINE-ROOM DEDUCTION.

SCREW STEAMER.

Measurement of actual engine room.

	Ft.
Breadth, fore end	12. 1
Ditto middle	12. 2
Ditto after end	12
	3)36. 3
	12. 1 mean breadth.
Shaft trunk.	11. 85 mean depth.
Ft.	
36 long.	143. 38
2 broad.	25 length.
72	3584. 5 ÷ 100 = 35. 85 engine room.
3 deep.	2. 16 shaft trunk.
Tons.	
216 ÷ 100 = 2. 16	38. 01 actual engine room.

The actual engine room being thus 38.01 tons and the gross tonnage being 206.51 tons (see par. 42), the percentage is $38.01 \times 100 \div 206.51 = 18.4$ per cent.

As the actual engine room is thus between 13 and 20 per cent of the gross tonnage, the allowance for propelling power in accordance with the act is 32 per cent of the gross tonnage, i. e., $206.51 \times .32 = 66.08$ tons.

If, however, the actual engine room did not exceed 13 per cent of the gross tonnage—if, for instance, it had amounted to only 26.8 tons (which is barely 13 per cent of 206.51)—the allowance would then be one and three-quarters times 26.8 tons, i. e., $26.8 + 26.8 \times .75 = 46.9$ tons.

But if, on the other hand, the actual engine room amounted to 20 per cent or more of the gross tonnage; if, for instance, it measured 59.89 tons, which is 28 per cent of 206.51 tons, the allowance would then have been one and three-quarters of 59.89 tons, or 104.81 tons, and if the vessel be a tug this would be the amount of the engine-room deduction from gross tonnage.

If, however, the vessel is not a tug, the allowance is subject to restriction under the provisions of the Merchant Shipping Act, 1907. For example, if the deductions under section 79 amount to 23.15 tons, the allowance would be restricted to 55 per cent of $(206.51 - 23.15)$ tons $= 100.85$ tons.

69. *Allowance for propelling power the same under Rules I and II.*—The method of measuring the engine room and computing the allowance for propelling power is the same whether the gross tonnage of the vessel has been computed under Rule I or Rule II.

DEDUCTIONS UNDER SECTION 79.

70. The surveyors should note the following instructions relating to the various deductions from tonnage authorized by section 79 of the Merchant Shipping Act, 1894, as amended by section 54 of the act of 1906.

71. *Master's and crew's spaces.*—Whenever practicable, the inspection of the master's and crew's spaces should be performed at the same time as the measurement of tonnage, and in considering whether these spaces are eligible for deduction from tonnage the surveyor should be guided by the provisions of the Merchant Shipping Acts and the board's "Instructions as to the Survey of Master's and Crew Spaces."

72. *General conditions for deductions.*—As regards the deduction of the spaces referred to in the following four paragraphs, the act provides that the space deducted must be reasonable in extent and properly and efficiently constructed for the purpose for which it is intended, and that it must be marked in the manner prescribed.

It should also be noted that no deduction can be allowed in respect of any space which has not been first included in the gross tonnage.

73. *Sail room.*—The sail room, deducted only in the case of a ship wholly propelled by sails, must be set apart and used exclusively for the storage of sails, and the space deducted must not exceed 2½ per cent of the gross tonnage of the ship. It must be efficiently constructed, and the words: "Certified sail room ..... tons," should be permanently cut in a beam within but near the entrance, and also cut in or painted on or over the doorway or hatchway.

74. *Spaces used exclusively for the working of the helm, capstan, and anchor gear.*—When situated above the upper deck these spaces are not included in the measurement,[1] and therefore will not be deductions under this section, but when situated below the upper deck such spaces are to be deducted from the tonnage if the requirements of the act are complied with.

75. *Chart room and boatswain's store.*—The chart room, used exclusively for keeping the charts, signals, and other instruments of navigation, and boatswain's store space are, under the provisions of the second schedule, added to the tonnage, and are, therefore, to be deducted wherever situated, subject to compliance with the requirements of the act.

In small vessels where the cabin or saloon is the only space available for chart purposes, and the surveyor is satisfied that charts are required, one-half the cabin or saloon, but not more than 3 tons, may be allowed for this purpose. The boatswain's store space to be allowed should not, as a rule, exceed 1 per cent of the gross tonnage in vessels of 1,000 tons gross and upward, but not more than 75 tons should be allowed in any ship, however large. In vessels from 500 to 1,000 tons gross the reasonable limit is about 10 tons, and in vessels of 150 to 500 tons 2 per cent of the gross tonnage may be allowed. In small vessels under 150 tons the allowance should not, as a rule, exceed 3 tons, and in fishing vessels that have no separate boatswain's storeroom this amount may be allowed for the boatswain's stores carried in the net room.

76. *Donkey engine and boiler space.*—(1) If situated within the boundary of the engine room or the casing above it, and if the machinery is used in connection with the main machinery for propelling the vessel, the space forms part of the actual engine room, and therefore should not be the subject of a separate allowance. (2) When the donkey boiler is in a house above the upper deck and not connected with the main machinery as described above, it is not subject to measurement in the gross tonnage of the ship,[2] and therefore must not form a deduction. (3) In all other cases the space occupied by the donkey engine and boiler, if connected with the main pumps of the ship, is to be allowed as a deduction from the tonnage, if reasonable in extent and properly and efficiently constructed.

77. *Marking.*—All the above-mentioned spaces, if deducted from the tonnage, must be marked similarly to the sail room, their proper designation being stated in each case.

78. *Water-ballast spaces other than double bottoms.*—These spaces include all water-ballast spaces (other than double bottoms), wherever situated, including forward and after peak tank spaces above the top of the double bottom or floors, and the surveyor must see that all such water-ballast spaces, whether situated above or below the upper deck, are first included in the gross tonnage whether deduction is claimed or not.

Application for the deduction of the water-ballast spaces named above must be made in writing by the builders or owners, and the spaces must comply with the following conditions:

(1) That they are adapted only for water ballast;

(2) That they are entered by an ordinary sized oval manhole only; and

(3) That they are marked as required by section 79.

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[1] See par. 38 (*a*) and (*b*).

[2] See par. 38 (*a*).

In every case in which these deductions are claimed the surveyor, when forwarding the formula to the principal surveyor for tonnage for examination, must report on form surveys 129 whether or not the foregoing conditions are fulfilled, and forward scale drawings of the spaces in question.

79. *Mode of measurement.*—When spaces for water ballast are of rectangular form the tonnage may be ascertained by multiplying together the mean length, breadth, and depth of the space, and dividing the product by 100; but the tonnage of peak tanks, and all other water-ballast spaces bounded by one or more curved surfaces must be ascertained in the manner provided for in the second schedule, Rule I, of the act.

80. All the particulars and measurements of the spaces deducted under section 79, including the computation relating to the deduction of spaces for water ballast, must be shown upon the back of form surveys 63.

81. *Use of forms and submission of measurements to principal surveyor.*—A list of the forms used in connection with tonnage measurement is here given. Reference has already been made, in the course of these instructions, to the use of certain of these forms.

List of forms used in connection with tonnage measurement.

Name of form.	Short title.	Relevant paragraph of instructions.
Application for tonnage measurement	Surveys 6	2, 115
Memorandum of measurements, for use at ship	Surveys 58A	11, 83
Formulæ of measurement under Rule I:		
Class 1. For vessels 50 feet long and under	Surveys 51	11, 26, 42, 81–3
Class 2. From 50 to 120 feet, and midship depth not exceeding 16 feet	Surveys 52	
Class 2A. From 50 to 120 feet, and midship depth exceeding 16 feet	Surveys 53	
Class 3. From 120 to 180 feet, and midship depth not exceeding 16 feet	Surveys 54	
Class 3A. From 120 to 180 feet, and midship depth exceeding 16 feet	Surveys 55	
Class 4. From 180 to 225 feet, and midship depth not exceeding 16 feet	Surveys 56	
Class 4A. From 180 to 225 feet, and midship depth exceeding 16 feet	Surveys 57	
Class 5. For vessels over 225 feet long	Surveys 58	
For vessels with double bottom for water ballast	Surveys 50	
Form for computing the tonnage of spaces	Surveys 50A	26
Particulars of engine and boiler space	Surveys 128	57
Surveyor's certificate as to light and air spaces	Surveys 117	59
Surveyor's report on deductions under sec. 79	Surveys 63	80, 81, 83
Surveyor's certificate as to water-ballast spaces	Surveys 129	78
Sketch for use when builder's drawings are not obtainable	Surveys 131	134
Certificate of survey for registry under Part I of the act	Surveys 59	82
Letter advising owner of completion of tonnage measurement	Surveys 59C	82
Report of marking of net tonnage, etc., on ship	Surveys 60B	----------
Certificate of British tonnage for issue to foreign ship	Surveys 60	105, 107
Suez Canal special tonnage certificate	Surveys 60A	114, 134, 154
Letter forwarding draft Suez Canal certificate to tonnage department	Surveys 60D	----------
Letter to owners notifying invalidity of Suez Canal certificate	Surveys 140	----------
Sketches for use in connection with Suez Canal tonnage measurement:		
Vessel with forecastle, bridge, and poop all separate	Survey 131A	134
Vessel with forecastle and bridge combined, and poop	Survey 131B	
Vessel with bridge and poop combined, and forecastle	Survey 131C	
Report of measurement of sea-fishing vessel for registry under Part IV of the act	Survey 59A	94
Report of measurement of Scottish sea-fishing vessel for registry under Part IV of the act	Survey 59B	
Half-yearly return of implements	Survey 135	99

The formula of measurement should be forwarded to the principal surveyor for tonnage for test and examination as soon as the measurement of the gross tonnage is completed.

In the case of the removal of any steam vessel before the engine room is fitted, from the port at which she has been built to some other port, for the purpose of taking in and fitting her machinery, the surveyor at the latter port will, if it is intended that the vessel shall not return to the previous port before sailing on her voyage, be directed to measure the engine room when sufficiently fitted, and the details of this measurement will then be transmitted to the port to which the vessel belongs, for the completion of her registry.

Before the formula can be finally signed by the examiner in the tonnage department, it must be accompanied by form surveys 63, but to save time and to facilitate the work, this form

MERCHANT SHIPPING ACT, 1894.

[Certificate of survey.]

Name of ship.	Port of intended registry.	Official number, if there has been any former registry.

Whether British or foreign built.	Whether a sailing or steamship; and if a steamship, how propelled.	Where built.	When built.	Name and address of builders.

		Feet.	Tenths.
Number of decks.....	Length from fore part of stem under the bowsprit to the aft side of the head of the sternpost.....		
Number of masts.....	Length at quarter of depth from top of weather deck at side amidships to bottom of keel.....		
Rigged.....	Main breadth to outside of plank.....		
Stern.....	Depth in hold from tonnage deck to ceiling at midships.....		
Build.....	Depth in hold from upper deck to ceiling at midships in the case of three decks and upward....		
Galleries.....	Depth from top of beam amidships to top of keel..		
Head.....	Depth from top of deck at side amidships to bottom of keel.....		
Framework and description of vessel...	Round of beam.....		
Number of bulkheads.	Length of engine room (if any).....		
Number of water-ballast tanks and their capacity in tons.....			

PARTICULARS OF DISPLACEMENT.

Total to quarter the depth from weather deck at side amidships to bottom of keel.....	tons.	Ditto per inch immersion at same depth.....	tons.

PARTICULARS OF ENGINES, ETC. (if any).

REGISTRY FORM No. 1 and SURVEYS 59. Prescribed by H. M. CUSTOMS

[SEAL OF COM. OF COUNCIL FOR TRADE.]

With the Consent of the Board of Trade.

No. of engines.	Description.	Whether British or foreign made.	When made.	Name and address of makers.	No. of and diameter of cylinders.	Length of stroke.	N. H. P. I. H. P. speed of ship.
	Engines.		Engines.	Engines.			
	Boilers. Number..... Iron or steel..... Pressure when loaded.....		Boilers.	Boilers.			

PARTICULARS OF TONNAGE.

GROSS TONNAGE.	No. of tons.	DEDUCTION ALLOWED.	No. of tons.
Under tonnage deck.....		On account of space required for propelling power.....	
Closed-in spaces above the tonnage deck, if any: Space or spaces bet. decks. Poop..... Forecastle..... Roundhouse..... Other closed-in spaces, if any, as follows:		On account of spaces occupied by seamen or apprentices, and appropriated to their use, and kept free from goods or stores of every kind, not being the personal property of the crew.....	
		These spaces are the following, viz:	
Spaces for machinery, and light and air, under sec. 78 (2) of the Merchant Shipping Act, 1894, if required.		Deductions under sec. 79 of the Merchant Shipping Act, 1894, as follows:	
		Cubic meters.	
Gross tonnage..... Deductions as per contra.....			
Registered tonnage.....		Total.....	

NOTE.—The only spaces above the upper deck not included in the cubical contents forming the ship's registered tonnage are.....

I, the undersigned....., having surveyed the above-named ship, hereby certify that the above particulars are true, and that her name is marked on each of her bows, and her name and the port of registry are properly marked on a conspicuous part of her stern, a scale of feet marked on each side of her stem and of her sternpost, and lines permanently and conspicuously marked on each side amidships indicating the position of each deck which is above water, in manner directed by the Merchant Shipping Act, 1894.

Dated at ——, this —— day of ——, 18—.

—— ——

Surveyor.

need not then contain more than a statement of the appropriation and dimensions of the spaces to be deducted from the gross tonnage of the vessel and the number of water-closets set apart for the crew and officers, respectively. The form will be returned to the surveyor for completion in due course.

82. When the forms have been completed and finally approved, the particulars of tonnage are to be entered on the form surveys 59, which is the certificate of survey referred to in section 6 of the act. On completion of this form in other respects, it is to be sent, together with the approved formula and the necessary certificate as to crew space,[1] to the registrar of shipping at the port of intended registry, and the form surveys 59 C should at the same time be sent to the owner informing him that the papers have been forwarded to the registrar.

83. As soon as the vessel has been registered, the official number should be inserted in the various forms, and the form surveys 63 should be forwarded to the principal surveyor for tonnage to be recorded and filed. The form surveys 58 A should be retained in the surveyor's office.

84. *Registry of alterations.*—Whenever it comes to the knowledge of the surveyors that a ship has been so altered as to cause an alteration in her tonnage, they should see that the necessary action is taken to have the vessel remeasured as far as necessary, and the alteration in tonnage registered under section 48.

85. In such cases the surveyor should apply to the principal surveyor for tonnage for the formula and papers of the previous measurement of the ship. No marks or alterations are to be made on these papers, but on completing the remeasurement the surveyor should prepare fresh papers showing the alterations and forward them for approval to the principal surveyor; at the same time the previous papers should be returned.

86. *Tonnage measurement of motor boats.*—Section 743 of the act provides that the provisions of the acts relating to steamers shall apply to ships propelled by electricity or other mechanical power, with such modifications as the Board of Trade may prescribe for the purpose of adaptation. Vessels fitted with oil engines or other motors for propelling purposes (whether auxiliary or otherwise) must therefore be regarded as steamers for the purposes of registry and tonnage measurement. The allowance for propelling power should, in accordance with section 78, be calculated in the same manner as for vessels propelled by steam power, but the space occupied by storage batteries or oil fuel must not in any case be included in the engine-room measurement on which the allowance is based. As the vessels in question are not wholly propelled by sails, no deduction can be made for sail room under section 79 (1) (*b*) of the act.

87. *Vessels of special type.*—If the surveyors are called on to measure vessels to which the tonnage regulations of the act and the directions contained in these instructions are not readily applicable owing to the manner in which the vessels are constructed or fitted, or for any other reason, full particulars of the case accompanied with the necessary drawings should be forwarded to the principal surveyor for tonnage for consideration and submission to the board if necessary, and the points on which instructions are desired should be clearly stated in the surveyor's report.

88. *Deck cargo spaces.*—The measurement of spaces occupied by deck cargo is performed by officers of customs and excise.

89. *Measurement of Admiralty ships.*—Provision is made, by section 80 of the act of 1906 and the order in council of March 22, 1911, for the registry of ships owned by the Admiralty but not forming part of the Royal Navy, viz, royal fleet auxiliaries such as oil carriers and hospital ships. If any such vessels are submitted for measurement with a view to registry, they should for the present be dealt with in accordance with the tonnage regulations of the Merchant Shipping Acts.

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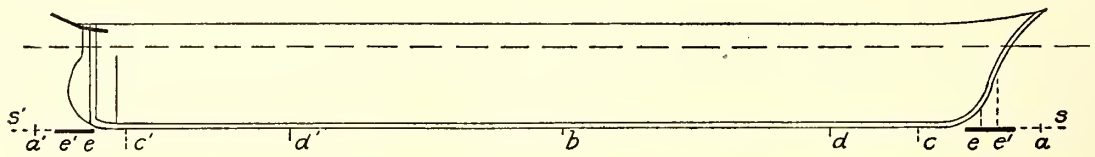
[1] See par. 34 of the "Instructions as to the Survey of Master's and Crew Spaces."

90. *Verification of draft of water marks.*—Before a vessel can be registered or reregistered the draft of water marks must be verified, unless the vessel has been exempted from this marking under section 7 (2).



In verifying the draft of water marks the surveyor must take proper means to test whether the keel is straight. This may be done by fixing three level sights or battens, one at each end (*a a'* on sketch), the other at the middle of the length of the vessel (*b*); the end ones should be below the line of sight (*s s'*), the middle one above. A ram line or baseboard (*e e'*) should then be placed at the stem in position of this line of sight, and also at the stern, and the several heights or figures tested square or perpendicular to such line or board. If the keel is not practically straight, but droops at the ends, the points for guidance will be *c c'*, and if low in the middle, *b* will be the point, with a parallel distance below at *d d'* or at any points equidistant from *b*, the greatest care being taken that the marks represent the depths from the lowest part or parts of the keel.

In the case of new vessels, opportunity should be taken of testing the marks at the time the builders are setting them off, when the necessary appliances will be at hand, and the builders will doubtless render every assistance.

91. *Official number.*—The official number of a British ship is never changed, and in the case of a vessel which is transferred to a foreign flag and is subsequently reregistered as a British ship, the original official number is reallotted to her on registry. If the surveyors, when surveying a vessel for registry, should have any reason to suppose that she has at any time been registered as a British ship, they are to make a special report of the circumstances to the registrar, and furnish him with the particulars of any official number marked on the main beam, in order that in all cases of reregistry the official number first given to the vessel may be retained as a permanent mark of the vessel's identity.

92. *Number of decks.*—When entering on the form surveys 59 the particulars as to "number of decks," the surveyors should enumerate as "decks" only those which are without such openings as exempt the spaces beneath from being included in the under-deck tonnage. In the case of vessels having other decks which contain such openings as exempt the spaces beneath from being included in the under-deck tonnage, these should be described separately after setting forth the number of decks proper. For instance, in the case of a vessel having two decks the spaces under which are included in the under-deck tonnage, and in addition a third deck containing such openings as exempt the space beneath from inclusion in such tonnage, the description should be as follows: "Two decks and shade deck."

93. *Description of vessel to be distinguished from description of rig.*—In dealing with barges, flats, trows, dumb barges, and other similar vessels, the surveyors should, in filling up the form surveys 59, be careful not to confuse the description of the rig with the description of the vessel.

The terms "schooner," "brig," "barque," etc., describe the rig.

The terms "barge," "billy-boy," "trow," "keel," "lighter," "lump," "wherry," "mud-flat," "dumb barge," "monkey boat," "canal boat," etc., on the other hand, describe the vessel and not the rig: e. g., what is known as a barge may be rigged in various ways, or not at all, and the rig of all the other vessels mentioned above is various.

In the case of barges and craft not rigged for sailing outside smooth water, the words "*dumb barge*," "*dumb flat*," "*canal boat*," etc., should be written in the form surveys 59 for description of vessel, and under the heading *rig* the words *not rigged* should be written.

Example.

Number of decks	
Number of masts	*Nil.*
Rigged	*Not.*
Stern	
Build	
Galleries	
Head	
Framework and description of vessel (*dumb barge* or "*canal boat*" or "*lighter*," etc., as the case may be).	*Wood.*
Number of bulkheads	
Number of water-ballast tanks, and their capacity in tons	

In cases where they are rigged for sailing, e. g., in the case of certain sailing barges on the Thames, the words "barge, sailing," should be written to describe the vessels, and "spritsail," or "topsail," as the case may be, to denote the rig.

Example.

Number of decks	
Number of masts	
Rigged	*Spritsail.*
Stern	
Build	
Galleries	
Head	
Framework and description of vessel	*Wood. Barge sailing.*
Number of bulkheads	
Number of water-ballast tanks, and their capacity in tons	

94. *Measurement of sea-fishing boats.*—The surveyors should be guided, as regards the measurement of sea-fishing boats, by the instructions contained in Circular 1503, issued in March, 1911, and Circular 1356, issued in October, 1903.

MISCELLANEOUS RULES AND TABLES.

95. *Number of decimal places necessary.*—The act prescribes that all measurements shall be taken in "feet and decimals of feet."

As the usual measure, or scale, is divided only into feet, tenths, and hundredths, the simple linear measurements taken thereby can never contain more than two places of decimals.

But, as in the arithmetical division and subdivision of these measurements any number of decimals may arise, it becomes necessary, in such a practical operation as the measurement of tonnage, to reduce this number to the fewest possible, consistent with practical correctness.

This practical correctness, except in the division and subdivision of the length and depths for ascertaining the "one-third of the common intervals," may be attained without employing more than two places of decimals, by simply taking care to increase the second decimal by one whenever the third amounts to the figure 5 or any higher number. Therefore, with this qualification, and the above exception, two places of decimals only may be used throughout the whole of the computation, as the discrepancy arising therefrom in the tonnage of a vessel of 1,500 tons amounts only to a fraction of a ton.

Example.—Suppose the measured length of a vessel to be 153.29 feet. This being divided by 8 in accordance with Rule I, gives 19.1612 feet for the common interval between the areas, which, being subdivided by 3, gives 6.387 for *one-third* of the common interval. Up to *this* point three decimals must be retained; but when using this last multiplier in the subsequent computation for tonnage, we need only take 6.39, instead of 6.387. If the third decimal had been under the figure 5, instead of above it, 6.38 simply would have to be taken. The same applies also to the computation of the areas.

96. *Decimal equivalents of inches.*—The following table of inches, or twelfths of a foot, expressed in their equivalents of tenths or decimals of a foot, with the adjustment to two places of decimals, as set forth in paragraph 95, will be found useful:

1 foot, or 12 inches, the integer.			
In.	Equivalents in decimals of a foot.	In.	Equivalents in decimals of a foot.
11	0.92	4	0.33
10	.83	3	.25
9	.75	2	.17
8	.67	1	.08
7	.58	¾	.06
6	.5	½	.04
5	.42	¼	.02

97. *Usual thickness of ceiling, etc.*—The following table of the usual thickness of ceiling, etc., may be useful for occasional reference:

Tonnage.	50	150	250	350	500	700	1,000	1,350	Above 1,350
	In.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
Average thickness of ceiling between decks	1½	2	2¼	2¼	2½	2	2¾	3	3½
Average thickness of ceiling below hold beams	1½	2	2½	2¾	3	3¼	3½	4	4½
Average thickness of bilge plank and limber strake	2½	3	3¼	3¾	4	4½	5½	6¼	6¼
Average thickness of tonnage deck	2½	2½	2½	3	3½	3½	4	4	4

98. *Reduction of tons to cubic meters.*—The gross tonnage, gross deductions, and net tonnage are to be reduced to cubic meters, and the result entered in the form surveys 59. The factor for conversion is 2.83, and the following table of equivalents will be found useful:

Tons.	Meters.	Tons.	Meters.	Tons.	Meters.	Tons.	Meters.
1	2.83	26	73.58	51	144.33	76	215.08
2	5.66	27	76.41	52	147.16	77	217.91
3	8.49	28	79.24	53	149.99	78	220.74
4	11.32	29	82.07	54	152.82	79	223.57
5	14.15	30	84.90	55	155.65	80	226.40
6	16.98	31	87.73	56	158.48	81	229.23
7	19.81	32	90.56	57	161.31	82	232.06
8	22.64	33	93.39	58	164.14	83	234.89
9	25.47	34	96.22	59	166.97	84	237.72
10	28.30	35	99.05	60	169.80	85	240.55
11	31.13	36	101.88	61	172.63	86	243.38
12	33.96	37	104.71	62	175.46	87	246.21
13	36.79	38	107.54	63	178.29	88	249.04
14	39.62	39	110.37	64	181.12	89	251.87
15	42.45	40	113.20	65	183.95	90	254.70
16	45.28	41	116.03	66	186.78	91	257.53
17	48.11	42	118.86	67	189.61	92	260.36
18	50.94	43	121.69	68	192.44	93	263.19
19	53.77	44	124.52	69	195.27	94	266.02
20	56.60	45	127.35	70	198.10	95	268.85
21	59.43	46	130.18	71	200.93	96	271.68
22	62.26	47	133.01	72	203.76	97	274.51
23	65.09	48	135.84	73	206.59	98	277.34
24	67.92	49	138.67	74	209.42	99	280.17
25	70.75	50	141.50	75	212.25	100	283.00

99. *Measuring tapes.*—Tapes should be frequently tested as to their accuracy, and they must be tested each time they are used during damp weather, one standard, as accurately laid down as practicable, being used for the test. At the principal port of the district a suitable stock of tapes with or without cases should be kept (together with other implements), from which the surveyors can draw from time to time on application to the principal officer, and at the end of every half year one report from each port should be sent to the board giving an account on the form surveys 135 of the number and condition of the implements in stock and those in use.

Whenever a tape has been exposed to the wet, it should be carefully hung up, dried, cleaned, and afterwards lightly rubbed with a piece of old cloth moistened with a little oil, and the surveyors should see that the tape holders do this and preserve the tapes clean and dry.

100. *Girting chain for Rule II.*—For girting ships in all cases of measurement by Rule II a curb chain of about $4\frac{1}{2}$ ounces to the foot and 70 feet long is supplied. A few feet of water-laid lanyard can be added at each end in the case of the larger class of vessels. The chain is marked as follows: A ring about 1 inch diameter is infixed at the middle of the length, and from the center of this ring the chain is tallied each way with small metal tallies 2 feet apart, having the figures 2, 4, 6, 8, etc., successively stamped on them. In girting a vessel it is only necessary to add together the two quantities shown by the tallies at each side of the deck to obtain the whole girth of the vessel.

In all cases the length of the chain should be frequently tested and the tallies readjusted when necessary. When not galvanized the chain should be kept, when out of use, in a bag of sawdust and whitening.

101. *Moorsom's measuring apparatus.*—The stanchion, which is for taking depths, is formed of a couplet of rods A and B, of equal lengths (see Fig. IV, p. 306); the upper or movable one, A, is termed the index rod, having an index between *o* and *n* traversing a scale, decimally divided, on the lower fixed rod B; the scale is not shown in the diagram, in order to avoid confusion.

The lift rods G, G, have one end of each fitted with plates having notches in them for the purpose of lifting the tape into position when the breadths are out of a man's reach and no ladder is at hand for the purpose.

Each lift rod is provided with a scale on it, decimally divided, for occasional convenience.

The short lift rods of No. 1 stanchion are found very useful in taking the main external breadths of ships, by placing a rod on the rough-tree rail and suspending the plumb line between the plates, moving the rod inward or outward till the line just touches the body of the ship. The scale on the lift rods is also found useful in setting off the position of the breadths on the stanchions.

Apparatus or stanchion No. 1: Rods of stanchion, 7 feet long, able to take all depths from 7 feet to 13 feet. Two lift rods, 5 feet long.

Apparatus or stanchion No. 2: Rods of stanchion, 11 feet long, able to take all depths from 11 feet to 21 feet. Two lift rods, 10 feet long.

It may first be observed that the divisions of feet on the scale rod B commence at the place of the index, when the ends of the rods are well together, and show at that point the constant length of the fixed rod B; by which arrangement it is manifest that the movable index will always show the number of feet, or depth, contained between the upper and lower points of the stanchion.

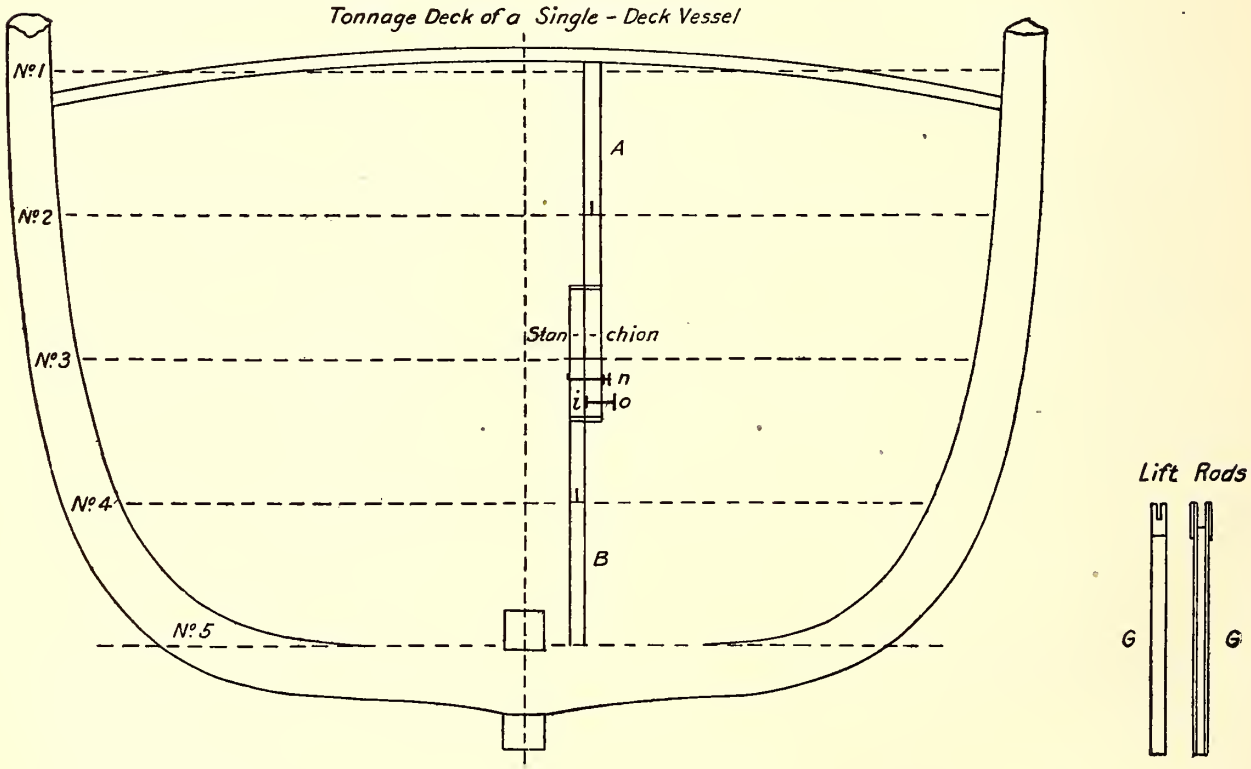
At the station of the area to be measured the stanchion is to be placed at the inside of the limber strake perpendicular, or square, to the line of the keel or keelson, and also parallel to the middle longitudinal plane of the ship, and forced up firmly under the deck and fixed in such position by the compressor *n*; from the depth thus shown by the index is then to be made the

necessary allowance, as prescribed by the act, for one-third of the round of the beam, and the average thickness of the ceiling (the head of the stanchion being supposed to be in contact with the underside of the deck and the heel on the floor timber), and the remainder is the depth of the area.

The depth of an area being taken as above is to be divided into the required number of equal parts. And supposing the stanchion as above fixed to be still in position, set off on it, above the average thickness of the ceiling, the said equal division, which gives the position, or

FIGURE IV.—Description of Moorsom's measuring apparatus.

[The diagram, being merely descriptive, is not drawn to scale.]



General references to figure. The diagram represents the midship section or area of a ship, with the measuring apparatus in position at the inside of the limber strake. A B, is termed the stanchion. G, G, are termed the two lift rods.

height, of the first breadth above the limber strake; and from this, when the stanchion is taken down, the heights of the remaining breadths are to be set off successively at equal distances.

The heights of all the breadths being thus severally marked on the stanchion, it is then set up again and firmly fixed in the position as aforementioned, and the breadths may be readily and correctly measured by means of the tape held at right angles across the stanchion at each of the heights marked thereon. In case any of the breadths required are out of a man's reach, and no ladder is at hand, the tape is to be lifted into position by means of the lift rods.

PART II.—MEASUREMENT OF FOREIGN SHIPS.

102. *Acceptance of foreign tonnage certificates.*—Section 84 of the act provides that, if the tonnage regulations of the Merchant Shipping Acts are adopted and put in force by any foreign

country, an order in council may be issued providing that the tonnage denoted in the certificates of registry of vessels belonging to that country shall be accepted, with or without qualifications.

103. The various orders in council which have been issued under the section referred to are printed separately for the surveyors' information,[1] but the following summary is given for convenience of reference.

104. The tonnage denoted on certificates of registry or other national papers issued after the date mentioned in the second column is to be accepted in the United Kingdom subject to the remarks contained in the third column.

Name.	Date.	Remarks.
Austria-Hungary	Sept. 1, 1871	
Belgium	Jan. 1, 1884	Steamers may be remeasured in the United Kingdom for engine-room allowance, unless the tonnage has been estimated under British rules and denoted on a national certificate of registry, issued after Jan. 1, 1898.
Denmark	Oct. 1, 1867	Steamships having certificates issued between Oct. 1, 1878, and Apr. 1, 1895, may be remeasured in the United Kingdom for engine-room allowance, unless in the case of national certificates issued between Sept. 1, 1882, and Apr. 1, 1895, the net tonnage has been estimated under British rules and denoted on the certificate.
Finland	June 1, 1877	
France	July 1, 1904	
Germany	Jan. 1, 1873	Steamships having certificates issued between Jan. 1, 1873, and July 1, 1895, may be remeasured in the United Kingdom for engine-room allowance unless, in the case of national certificates issued between June 20, 1888, and July 1, 1895, the net tonnage has been estimated under British rules and denoted on the certificate.
Greece	July 14, 1909 (O. S. July 1, 1909.)	Greek vessels unprovided with a national certificate dated on or after July 14, 1909, or a valid certificate of British tonnage, are subject to remeasurement in the United Kingdom.
Haiti	Jan. 26, 1882	
Italy	Feb. 10, 1906	
Japan	July 1, 1884	
Netherlands	Jan. 1, 1876	Steamships having certificates issued between Jan. 1, 1876, and Sept. 18, 1899, may be remeasured in the United Kingdom for engine-room allowance, unless the net tonnage has been estimated under British rules and denoted on a separate national certificate, issued between Jan. 6, 1888, and Sept. 18, 1899.
Norway	Oct. 1, 1893	
Russia	Dec. 20, 1879	Steamships having certificates issued between Dec. 20, 1879, and Mar. 2, 1900, may be remeasured in the United Kingdom for engine-room allowance.
Spain	Apr. 1, 1910	If the certificate does not bear a note [2] stating that the measurements have been made in accordance with the Board of Trade rules, instructions should be sought as to the remeasurement of the vessel.
Sweden	Apr. 1, 1875 (sailing ships); Apr. 1, 1881 (steamships).	Steamships having certificates dated after Apr. 1, 1881, may be remeasured in the United Kingdom for engine-room allowance, unless the net tonnage has been estimated under British rules and denoted on a separate national certificate.
United States	Jan. 1, 1865	Steamships having certificates issued before Apr. 1, 1895, may be remeasured in the United Kingdom for engine-room allowance.

105. *When British tonnage certificates are compulsory.*—Vessels belonging to any country not mentioned above, or vessels which, though belonging to one of the countries mentioned, hold certificates issued before the respective dates given above, are subject to measurement for tonnage in ports of the United Kingdom, and must obtain a certificate of British tonnage (form surveys 60). For this purpose they must be measured by the board's surveyors in accordance with the requirements of the acts and these instructions, and the surveyor should note that, if the vessel has cargo on board, or if the holds are so lumbered with stores, dunnage, or ballast, or so fitted with bulkheads or cabins, as to prevent the prescribed measurements by Rule I being correctly taken, she may be measured by Rule II subject to the approval of the Board of Trade. In such case the reasons for adopting Rule II should be stated in the space provided in the certificate.

[1] See Circulars 1297, 1386, and 1523.

[2] In Spanish: "El cálculo de arqueos y los descuentos en este certificado insertos se han llevado a cabo con sujeccion a las reglas dictadas por el Board of Trade."

Foreign ships measured by Rule II may at any subsequent period be remeasured under Rule I, on the master making application and paying the prescribed fees.

The formula of measurement together with form surveys 60 in duplicate is to be sent to the office of the principal surveyor for tonnage for test and examination before the certificate is issued.

106. The certificate remains in force for three years from the date of issue, unless alterations affecting the tonnage of the vessel are made, in which case a new certificate must be obtained. At the end of three years, a fresh form bearing the date of the last survey may be issued, if the principal dimensions of the vessel, on being tried, are found to agree with those stated in the certificate, and if the surveyor has no reason to doubt the accuracy of the tonnage.

107. *When certificates are optional.*—Vessels measured under foreign regulations which agree with the tonnage regulations of the Merchant Shipping Acts, except as regards the allowance for propelling power, may, if desired, be remeasured in the United Kingdom for engine-room allowance, as indicated in the list above, and may be supplied with certificates of British tonnage, indicating the allowance for propelling power as ascertained by the British rules. In all such cases the registered dimensions and gross tonnage are to be accepted as they appear upon the national certificate of registry and the deductions for propelling power only are to be dealt with in the manner applicable to British ships. The surveyors must be careful not to include the engine and boiler casings above the upper deck in the measurement of the actual engine room unless they are clearly indicated upon the national certificate of registry as being included in the gross tonnage. No alterations whatever are to be made in such other deductions as may be shown upon the national certificate of registry in arriving at the net register tonnage upon the form surveys 60.

Whenever practicable the surveyor, when forwarding the formula and form surveys 60 to the principal surveyor for tonnage for examination, should accompany these with a copy of the respective items forming the gross tonnage and the deductions, as shown upon the national certificate of registry.

108. In order to make it clear that the certificates of British tonnage issued in these cases do not attest the gross tonnage or any of the deductions except the allowance for propelling power, the form surveys 60 must, before issue, be altered to read as follows:

"I hereby certify that I have measured the *engine and boiler spaces of the* . . . , of . . . , in accordance with rule , as prescribed by the Merchant Shipping Acts, 1894 to 1907, and, by this rule, the gross tonnage *according to her national papers being* . . . , the net register tonnage is . ."

On the back of the certificate the words "According to British rules" should be inserted against the propelling power allowance, and the words "According to national papers" inserted against the gross tonnage and other deductions.

109. In the case of new vessels constructed in the United Kingdom for foreign owners, whether belonging to a country in respect of which an order in council has been issued or not, certificates of British tonnage may be issued if desired, calculated in the usual manner, but they will only remain in force until the national certificate of registry has been granted, and a note to this effect will in such cases be inserted on the certificate before it is issued.

110. Certificates of British tonnage may be issued on similar conditions to British vessels transferred in the United Kingdom to foreign owners. If in such cases the ship, on being surveyed is found to agree with the tonnage set forth in the copy of the certificate of British registry, which is to be furnished by the owner, a certificate of tonnage is to be issued in accordance with the tonnage set forth therein.

111. *When certificates are not to be given.*—Except as stated above, certificates of British tonnage are not to be issued to vessels belonging to countries which have adopted the tonnage regulations of the Merchant Shipping Acts, and in respect of which an order in council has been issued as explained above; but if at any time there is reason to believe that the national cer-

tificate of registry of any such vessel does not correctly set forth the tonnage, the surveyor should report full particulars of the case to the Board of Trade.

112. *General.*—The surveyors should note that collectors of customs are instructed that if, owing to the language in which the national certificate is issued, difficulty is experienced in ascertaining the tonnage of a vessel belonging to a country in respect of which an order in council has been issued, the master or agent of such vessel is to be required to furnish all necessary information as to the contents of the certificate.

113. It will be understood that, in all cases, fees must be paid for the issue or renewal of certificates of British tonnage in accordance with the printed list of fees and expenses. The fee for a copy of a certificate of British tonnage is two shillings and 6 pence.

APPENDIX V.

THE SHIP MEASUREMENT ORDINANCE OF GERMANY.

APPENDIX V.

THE SHIP MEASUREMENT ORDINANCE OF GERMANY, MARCH 1, 1895, 1908 EDITION, INCLUDING ALL REVISIONS UP TO APRIL 12, 1908. AUTHORIZED BY THE IMPERIAL DEPARTMENT OF THE INTERIOR. BERLIN, 1908.[1]

The Regulations for the Measurement of Seagoing Ships have been modified since 1895 by the following ordinances and enactments: Federal enactment publications of the chancellor of May 22, 1899, in the Imperial Legal Gazette, page 310. May 7, 1906, in the "Zentralblatt Fuer das Deutsche Reich," page 564. April 12, 1908, in the "Zentralblatt Fuer das Deutsche Reich," page 156. April 12, 1908, in the Imperial Legal Gazette, page 149, and ordinances of the secretary of state of the department of the interior of March 26, 1901, III, 1247; June 10, 1905, IIIA, 2351; December 18, 1907, IIIA, 7287.

[1] Translated by Second Lieut. Edward B. Dennis, Coast Artillery Corps.

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I. *Ship measurement ordinance. Announcement concerning the interpretation of the ship measurement ordinance of March 1, 1895.*

As Article IV of the regulations of March 1, 1895, amends the ship measurement ordinance of June 20, 1888, the ship measurement ordinance with these revisions is published in the following submitted text.

VON BOETTICHER,
Acting Imperial Chancellor.

BERLIN, March 1, 1895.

GENERAL CONSIDERATIONS.

ARTICLE 1. The following regulations are applicable to all ships, vessels, and boats which, in the meaning of the promulgation of November 10, 1899 ("Zentralblatt" of the German Empire, p. 380), concerning the execution of article 25 of the marine law of June 22, 1899, are intended exclusively or mainly for sea voyages.

It is left to the discretion of the government of a State to determine whether and to what extent vessels of less than 50 cubic meters gross tonnage, which are not provided with permanent crew quarters, may be excluded from measurements.

ART. 2. To ascertain the capacity of a ship its tonnage is established by measurements. The measurements, subject to the limitations hereafter specified, include the spaces located under the uppermost deck of the ship and the permanent superstructures on or above the uppermost deck.

The result of these measurements expressed in cubic measure is called the gross tonnage, and after deduction of the spaces more accurately defined in article 14, the net tonnage of the ship.

ART. 3. The measurements are determined by the complete method of procedure as prescribed in articles 4 to 16.

In exceptional cases, however, the abbreviated method of articles 18 and 19 may be applied when the ship is entirely or partly loaded or when various other circumstances prevent its measurement by the complete method.

II. *Complete method of measurement.*

ART. 4. (See Appendix 7 to this report, "Technical Directions," Art. I.)

That deck, which is the upper in ships having less than three decks, and which is the second from below in ships having three or more decks, is called the tonnage deck.

The hold under the tonnage deck is to be measured as a separate entity.

The spaces situated over the tonnage deck, which may be created by decks or by superstructures erected on or above the upper deck, are individually measured.

ART. 5. The measuring of the cubic contents of the ship below the tonnage deck is made by spacing lengths, dividing each one of these lengths proportionately into a different number of cross sections, and by a calculation according to the rules given in articles 6, 7, and 8.

ART. 6. The lengths are measured on the tonnage deck in straight lines, from the middle surface of the inner planking (middle thickness) next the stem to the inner surface of the central stern stay, or to the sheeting (middle thickness) situated amidships at the stern.

From these lengths a deduction is made, consisting in the drop of the bow, of the thickness of the deck; in the drop of the stern stays, of the thickness of the deck; and in the drop of the stern stays, of a third of the deck curvature.

A length determined in this manner is divided into a number of equal parts:

(1) A length up to 15 meters into 4 equal parts.

(2) A length up to 37 meters into 6 equal parts.

(3) A length up to 55 meters into 8 equal parts.

(4) A length up to 69 meters into 10 equal parts.

(5) A length over 69 meters into 12 equal parts.

ART. 7. At each of these dividing points a cross section of the space situated below the tonnage deck is measured in the following manner:

The depth of each cross section is taken as the normal distance between two points which lie in a longitudinal plane, one of which lies in the under surface of the tonnage deck or its continuation, the other in the upper surface of the bottom covering or its continuation next to the keelson, deducting a third of the deck curvature, in this cross section and the middle thickness of the attached or permanently located covering.

In ships with a double bottom for water ballast, in which, according to the above-established rules of the Bureau of Registry, the room situated between the inner and outer bottom not being used for the storage of freight, stores, or fuel, the height of each cross section is measured from the under surface of the tonnage deck or its continuation to the upper side of the upper plates of the double bottom, deducting a third of the deck curvature (round of the deck) of the tonnage deck and the middle thickness of the covering located on the double bottom.

If the depth of the cross section located at the central dividing point amounts to not more than 5 meters, then the depth of each cross section will be divided into four equal parts. Through each of the three middle dividing points, as well as through the top and bottom terminal points of the depth, the distance is measured so that the internal width of each cross section is perpendicular to the longitudinal dividing plane, each measurement being taken to the inner continuation of that part of the inner planking which lies between the two measuring points.

For the purpose of calculating the surface contents of the cross sections, the widths of each cross section as measured are so numbered that the upper width is designated by 1 and the following widths by 2, 3, 4, and the lowest width by 5. The resulting sum, which is obtained when the second and fourth widths are multiplied by 4 and the third width by 2, and the products are added to the first and fifth widths is separately multiplied by a third of the whole height of the widths. The product represents the surface contents of the cross section.

If the depth of the cross section through the central dividing point amounts to more than 5 meters, then the depth of each cross section is divided into 6 parts instead of 4, so that instead of five widths seven widths are measured. The measuring and calculating are done in the same manner; that is, the second, fourth, and sixth widths are multiplied by 4, the third and fifth by 2, and to the sum of these products are added the first and seventh widths. This total is multiplied separately by a third of the whole height of the width and the result represents the surface contents of the cross section.

ART. 8. From the surface contents of all the individual cross sections determined according to the rule of article 7, the cubic contents of the space situated below the tonnage deck are calculated in the following manner:

The cross sections are numbered consecutively 1, 2, 3, etc., in such a way that the cross section denoted by 1 is plotted through the starting point of the bow length and the one denoted by the last number through the terminal point of the stern length. The figure resulting, when each even numbered cross section is multiplied by 4 and each odd numbered cross section with the exception of the first and last by 2, and to the sum of these products are added the first and last cross section, so far as these are shown to have a surface contents, is separately multiplied by a third of the common height of the cross section. The product gives the cubic contents of the space situated below the tonnage deck.

ART. 9. (Rescinded.)

ART. 10. (See Appendix 7 to this report, "Technical directions," Art. I.) If the ship has a third deck, one above the tonnage deck, the cubic contents of the space between the third and the tonnage deck (between decks) is estimated in the following manner: The inner length of the space is measured from the inner surface of the covering next the stem to the inner surface of the stern covering. This length is divided into the same number of equal parts as the length of the tonnage deck (art. 6). At each of these division points the normal distance of the lower surface of the third deck is first measured from the upper surface of the tonnage deck or its continuation, and the arithmetical mean of these measurements is the average height of that space. At each of these imaginary division points and also at the terminal points of the stem and stern lengths the internal widths are measured according to article 7 at half height. In the case of compartments whose side walls are intersected by the curve of the upper deck, instead of measuring the widths from the half height they are measured at a third of the height of the curvature.

These widths are successively denoted in such a manner by 1, 2, 3 that the width of the stem is No. 1. All designated by equal numbers are multiplied by 4, and all widths designated by odd numbers, with the exception of the first and last, are multiplied by 2. The sum of these products and that of the first and last widths are multiplied separately by a third of the common distance of the widths from each other. The product gives the surface area of the middle horizontal cross section, and this multiplied by the height of the space as defined in the second article gives the contents of the measured space.

ART. 11. If the ship has more than three decks, spaces between decks located over the tonnage deck are measured separately according to the rule in article 10.

ART. 12. The cubic contents of the permanent and closed-in structures on or above the upper deck, which should be added to the gross tonnage of the ship, are computed in the following manner:

The inner middle length is measured and divided into two equal parts. The three inner widths are measured at half the height of the space, one through each terminal point and one through the middle of the measured length. To the sum of both the end widths is added four times the middle width, and the total is separately multiplied by a third of the common distance of the widths from each other. The product gives the surface area of the middle horizontal cross section, and this multiplied by the half heights of the space gives its cubic contents.

Those points at which the middle length and the rear width of the superstructure are to be measured and whose rear wall is built through a round stern are measured according to the more exact rule of the Bureau of Registry.

In spaces the side walls of which are rounded, the widths are not measured at the half height of the space but at a third of the rounded height from below.

In case of rooms which are bounded by quadrilaterals, the inner middle length, width, and height are multiplied together. The product gives the cubic contents of the space.

ART. 13. *A*. The following spaces are included in the gross tonnage: (*a*) The space occupied by all covered and inclosed superstructures permanently erected on or above the first deck which are inclosed by substantial bulkheads and coverings, suitable for the storage of freight or merchandise, or for quarters or other accommodation of the crew and passengers (see Appendix 7 to this report, "Technical directions," Art. II); (*b*) hatches in excess of one-half of 1 per cent of the gross tonnage.

B. Exceptions to Aa are as follows, so far as the following designated spaces are located in that kind of a superstructure: (*a*) All covered and inclosed spaces which are used exclusively for the operation of the auxiliary machinery, and also the pilot house for the protection of the men at the steering wheel, provided these spaces are not larger than necessary for the purpose specified; (*b*) each structure necessary on short voyages for the protection of deck passengers against storm and waves, if the measurement board is authorized to exempt it by the bureau of registry; (*c*) the kitchen (galley) and the place for the distilling apparatus, provided they are not larger than actually necessary for the preparing of meals, at the same time affording sufficient shelter to the machinist while distilling water for the passengers and the crew (see Appendix 7

to this report, "Technical directions," Art. III); (*d*) toilets for the officers and crew of the ship, provided they do not exceed the proper number and size.

On ships designed for the transportation of passengers a toilet for every 50 persons can be omitted from the calculation.

The number of toilets excluded from measurement shall not exceed 12 in all.

III.—*Deduction from gross tonnage.*

ART. 14. In determining the net tonnage the following deductions are made from gross tonnage, but no spaces are deducted from the gross tonnage which were not first included in the gross tonnage:

A. Spaces used for the ship's crew and for the navigation of the ship—that is:

(1) All separated spaces above and below the upper deck which are used exclusively by the ship's crew, such as sleeping, bathing, wash and toilet rooms, so long as they are considered by the authorities as conforming to the regulations of July 2, 1905. (Imperial Law Bull., p. 563.)

(2) Every room which is used exclusively by the captain of the ship.

(3) All rooms which are used for the following purposes:

(*a*) For handling the steering wheel, gong signals, and anchor.

(*b*) Spaces used for storage of charts, signal devices, and other navigation instruments and provisions.

(4) Auxiliary engine and boiler rooms containing machinery to assist in operating the ship's main pump.

(5) Spaces used for water ballast only, but not double bottoms, which are exempted under section 7, paragraph 3. (See Appendix 7 to this report, "Technical directions," Art. IV.)

(6) In case of ships which are navigated by means of sails only, the space for storage of sails is deducted, but the deduction shall not exceed $2\frac{1}{2}$ per cent of the gross tonnage.

Each space named above shall, when a deduction is to be made, be large enough for the purpose for which it is intended. It must be appropriately constructed and fitted out and be marked in a conspicuous place to indicate the purpose for which it is used.

The rule given in article 12 should be followed in the measurement.

B. In ships which are navigated by steam or other artificial power, further deduction must be made from the gross tonnage for the space occupied by the propelling machinery.

The amount of the deduction is ascertained in the following manner:

(*a*) In side-wheel steamers, if the engine room, containing only the engine and boilers and such space as is necessary for efficient handling of the same, occupies more than 20 per cent and less than 30 per cent of the gross tonnage, 37 per cent shall be deducted from the gross tonnage.

In screw-propeller steamers, if the engine-room space is more than 13 per cent and less than 20 per cent of the gross tonnage, 32 per cent shall be deducted from the gross tonnage.

(*b*) If the size of the engine room is not within the proportions laid down in section (*a*), the deduction in case of side-wheel steamers may be made by adding 50 per cent and in propelling steamers 75 per cent to the engine room.

In making the choice indicated in section (*b*), the following rules shall be observed:

If the size of the engine room in side-wheel steamers does not exceed 20 per cent and in screw-propeller steamers 13 per cent of the gross tonnage, the measurement boards shall make the deduction according to the rules in section (*b*), provided they are not required by the bureau of registry to act according to the rule in section (*a*).

If the size of the engine room of side-wheel steamers is 30 per cent or more and in screw-propelling steamers 20 per cent or more of the gross tonnage, the owner is at liberty to choose either of the two rules in making the deduction. If he does not avail himself of this privilege, then the measurement boards must proceed as described in the foregoing paragraph.

ART. 15. The measuring of the spaces actually occupied by the engine and boilers and those which are necessary for efficient operation and proper service is to be carried out as follows:

1. The middle depth of the space is measured from the under surface of the deck over the engine to the upper surface of the flooring or its continuance next to the keelson or to the upper

surface of the inner double bottom. At half height of the space at least three widths are measured. The arithmetical mean is taken of the widths measured. Then the middle length of the space is measured between the fore and aft, limiting bulkheads or other limiting objects. However, it is to be noted that such portions of the space as are not actually occupied by the engine and boilers, or are not necessary for the efficient running and proper service of the same, are not included in the measurement. The principal measurements of the engine room thus determined are multiplied together. The product represents the cubic contents of the engine room under the deck lying immediately above. Next the cubic contents of the spaces above this deck, which are intended for lighting and ventilating the engine room, are measured in such a manner that the product for each is obtained from its middle length, breadth, and depth. The total contents of these spaces is then added to the contents of the engine room.

2. In case the engine and boilers are contained in separate bulkhead compartments, the cubic contents of each compartment will be obtained according to the foregoing rules. The sum of their cubic contents is taken as the cubic contents of the engine room.

3. In screw-propelling steamers the space occupied by the shaft is considered as part of the engine room. To determine the cubic contents of the tunnel the product of its average length, breadth, and thickness is taken. If the tunnel consists of more than one compartment each is separately measured. (See Appendix 7 to this report, "Technical directions," Art. V.)

4. The spaces situated above the upper deck, which are intended exclusively for the engines or for light or air, may be added to the engine and boiler rooms and to the gross tonnage of the ship, only if each space is of suitable size, is so constructed as to be safe and seaworthy and can not be used for any other purpose than for the machinery or for the admittance of light and air to the engine and boilers. (See Appendix 7 to this report, "Technical directions," Art. VI.)

ART. 16. If the spaces of a ship in conformity to article 14 are deducted from the gross tonnage and later used for other purposes than described in article 14, they shall be added to the net tonnage. The measuring boards will decide whether or not in such case a new measurement is necessary.

ART. 17. (Rescinded.)

IV.—*Abbreviated measurement method.*

ART. 18. The length is measured on the upper deck from the inner surface of the inner planking next to the stem, to the rear edge of the back stay, and in ships with a patent rudder to the center of the rudder.

The greatest width of the ship is measured between the outer surfaces of the outer covering or between the main beams. The height of the upper deck is marked externally on both sides at the greatest width; and, by means of a chain drawn tight around the ship at right angles to and under the keel, the length of the line passing under the keel which connects one of the designated points with the opposite point is measured.

To half of this external circumference is added half of the greatest width. The resulting sum is multiplied by itself, and by the length of the ship ascertained according to paragraph 1; and the product is once more multiplied by 0.18, if the ship is principally constructed of iron, and by 0.17, if chiefly built of wood. The result represents the contents of the ship's space, which is located under the upper deck, in cubic meters.

ART. 19. The measuring of covered and inclosed spaces in the permanent ship structure on or above the upper deck follows the rule of article 12, and the deductions from the gross tonnage are made according to the rules laid down in articles 14 and 15.

V.—*Measuring of vessels without decks.*

ART. 20. In calculating the gross tonnage of vessels without decks, a horizontal surface passing through the upper edge of the permanent strake is regarded as the lower surface of the tonnage deck. The depths are measured from the crosslines, which are drawn from upper edge to upper edge of the highest strakes through the dividing points of the length.

The rules of Sections II and III are applied in all other instances.

VI.—*Measuring authorities and the preparation of measurement certificates.*

ART. 21. The measuring is conducted by measurement boards appointed by the State governments. A marine engineer must be appointed as one of the members of each board.

ART. 22. The supervision over the measuring of ships, including the revision of the measurements, is performed by the Bureau of Registry, which has its headquarters at Berlin. The bureau is subordinate to the imperial chancellor.

ART. 23. The Bureau of Registry is authorized to provide the measurement boards with technical instructions for the administration of the measurement ordinance, to inspect the drawings and calculations of the boards, to discover any defects, to determine the manner in which the measurements shall be made in the case of ships to which, because of their construction, some of the present rules of the ordinance are not applicable, and to instruct the boards in the taking of new measurements according to articles 16 and 35.

The members of the bureau are permitted to be present at the taking of the measurements.

All measurement forms with technical notations must be forwarded by the measurement boards to the Bureau of Registry.

ART. 24. The preparation of the measurement certificates is executed solely by the measurement boards from their own measurements in case of the following vessels:

(*a*) Those German ships which are not registered according to the law regarding the nationality of merchantmen enacted June 22, 1899. (Imperial Legal Bull., p. 319.)[1]

(*b*) Those foreign ships which were remeasured after the determination of the net tonnage.

(*c*) Those ships measured according to the abbreviated method.

When an objection arises egarding the measurement certificate, the Bureau of Registry is authorized to order the issue of a new one.

The measurements and calculations taken by the measurement boards for the following ships measured according to the complete rules, are checked up by the Bureau of Registry:

(*a*) Vessels which are registered according to the law of the nationality of merchantmen, enacted June 22, 1899. (Imperial Legal Bull., p. 319.)

(*b*) Vessels registered under foreign flags, in so far as their measurement does not require a remeasuring. (Sec. 1b.)

The execution of the certificate for these ships is accomplished through boards appointed by the State governments, according to the regulations of the Bureau of Registry.

These officials are required to report the certificates which they issue to German ships to the respective measurement boards, and also the tests and adjustments made to verify the instruments used by them in taking the measurements.

At the request of any of the German States, the Imperial Chancellor may transfer to the Bureau of Registry the duty of the State under sections 4 and 5 as to the measurement of vessels.

ART. 25. In order to establish the identity of the ship, the measurement boards will take the following principal measurements before issuing the certificate:

1. In case of ships with decks:

(*a*) The length from the rear surface of the stem to the rear surface of the stern stay, in case of ships equipped with patent rudders to the center of the rudder, measuring along the upper permanent deck.

(*b*) The greatest width of the ship between the external surfaces of the outer sheathing, or between those of the main beams.

(*c*) The depth between the lower surface of the highest permanent deck and the upper surface of the flooring near the keelson, or the upper surface of the inner iron bottom (if there is a double bottom) at the middle of the length found in 1a.

(*d*) On steamers, the greatest length of the engine room, including the compartments for the storage of fuel, extending from side to side and between the bulkheads.

If the measurements have been found by the abbreviated method, the external circumference determined according to article 18 is substituted for the depth described under 1c.

[1] Note 4, p. 327.

2. In case of vessels without decks:

(*a*) The length from the rear surface of the stem to the rear surface of the stern stay, at the height of the upper edge of the uppermost strake.

(*b*) The width between the external surface of the sheathing at the middle point of the length found in A2.

(*c*) The depth from the point given in the second paragraph of article 20 to the upper surface of the flooring in the middle of the length found in 2a.

ART. 26. Before beginning each set of measurements the measurement boards must determine whether or not the ship in its present condition has already been measured by a German measurement board, according to the complete method described in articles 4 to 17. If such is the case, the application for measurement is refused.

Before issuing the certificate the board must satisfy itself—

1. In case the measuring of the ship has become necessary through reconstruction, that the structure is finished and that all superstructures on the upper deck and all internal arrangements are completed.

2. In case the ship is provided with an old German certificate, that it be returned (article 29) or its loss be credibly established.

ART. 27. A certificate is issued for each measurement. On this certificate, next to the figures indicating in cubic meters the gross and net tonnage, is shown the corresponding number of British registered tons.

For the conversion of cubic meters into British registered tons, one cubic meter is taken as the equivalent of 0.353 British registered tons.

If the measuring was performed by the abbreviated method, the reason for not using the complete method must be stated in the certificate.

When the reason for using the abbreviated method no longer exists, a new measurement according to the complete method must be made as soon as the ship arrives at a German port.

ART. 28. In case the measuring takes place because of structural changes, and a certificate is subsequently issued, the dimensions of those parts which were not changed by the reconstruction are transferred to the new certificate without being remeasured.

This likewise applies in article 27, paragraph 3, in case of the new measurements of any spaces which are already measured according to article 19.

ART. 29. The boards intrusted with the preparation of certificates (art. 24) must keep a record, in which a copy of each completed certificate is entered according to the date of issue. They must preserve all the data and calculations, and all returned certificates. (Art. 26, No. 2.)

VII.—*Duties of the builder, owner, and master of a ship relative to measurement.*

ART. 30. The space under the tonnage deck of a ship in the course of construction is measured as soon as the deck is laid. The builders are required to send a written notice of this occurrence to the proper board within a reasonable time.

ART. 31. In case of ships which are built for German registry, including those ordered in foreign countries, two copies of each of the following designated drawings, which must correspond to the condition of the ship at the time the drawing was made, must be submitted to the board by the owner at least four weeks before the measurement:

1. A drawing of the cross section on which is shown the construction of the double bottom, if there is one, and the strength of the material.

2. A view of the longitudinal section, on which are shown the dimensions of the double bottom (if there be one), the position of the watertight bulkheads, the compartments for water ballast, the superstructure, hatchways, and other arrangements.

3. Deck plans, on which are shown the arrangement and use of the different compartments.

4. Drawings showing the arrangement of the engine, boiler, and fuel compartments.

The drawings must contain the prescribed specifications in such degree of finish as in the opinion of the Bureau of Registry is required for the revision of the measurements, and they must be made to the scale generally used for marine drawings.

If changes are later made, the revised plans must be delivered as soon as possible.

ART. 32. During the measurement operations the owner and the master of a ship, either personally or through their representatives, are required to give any aid or information to the board which is necessary in order to take the measurements.

Likewise they must comply with any contingent request to clear the ship for the purpose of measuring which the board may make of them.

The cargo or ballast can not be loaded before the termination of the measuring without the consent of the board.

ART. 33. If changes in space occur by reason of a reconstruction which is not considered in the preparation of the certificate, then whoever causes the reconstruction is required to give a written notification of it to the proper board, or if the reconstruction is accomplished in a foreign land the master of the ship is required to give this notification to the board at the first domestic port at which he touches. The board decides whether or not new measurements are to be taken of the reconstruction.

The owner or the master of the ship is required to give a similar notice as soon as the cause which has determined the measurement by the abbreviated method no longer exists.

ART. 34. The duties mentioned in articles 32 and 33 apply also to all changes in the use of those compartments which have been deducted from the gross tonnage under article 14.

ART. 35. In order to retain control of the measuring operation, the measurement boards are authorized to measure a ship without being requested.

In such case the rules of article 32 respecting the duties of the owner and of the master are also applicable.

Charges for such a measurement are made only when it is found that notice regarding changes in the vessel's construction or in the use of the compartments, deducted according to article 14, has not been given.

ART. 35a. If it is shown that the specifications of the certificate no longer apply to the conditions in articles 33, 34, and 35, the certificate must be surrendered to the measurement board.

If the owner or master neglects to do this, the certificate is revoked on recommendation of the board.

VIII.—*Measurement fees.*

ART. 36. The fees for measurement and for the execution of the certificate, including the cost of the stamp, amount to—

1. If the measuring was carried out according to the complete method, 5 pfennigs for each original cubic meter of the gross tonnage, but at least 2 marks.

2. If the measurements were taken according to the abbreviated method or were taken for vessels without decks, one-half the amount required under No. 1.

3. If the measurements relate to individual spaces only, 5 pfennigs for each original cubic meter of the measured space, but at least 2 marks.

4. If the builders, owner, or master of the ship fail to perform the duties required of them by articles 30 to 34 or do not give notice at the proper time, double the fee fixed under No. 1.

If through neglect the owner fails to give notice of the alterations mentioned in articles 33 and 34, a measuring subsequently requested by him is noted as being too late to perform.

5. If under the conditions mentioned in article 35, paragraph 2, no request for a subsequent measurement has been made, ten times the amount which is required in paragraph 1.[1]

[1] For the repeated issue of the certificate according to formula A without previous measurements the fee for vessels up to 200 cubic meters gross tonnage amounts to 4 marks, and for larger vessels 5 marks. When according to formulas B and C, 1 mark. Decision of July 19, 1890, and of Sept. 21, 1900. "Zentralblatt" for the German Empire, pp. 281 to 523.

IX.—*Concluding instructions.*

ART. 37. The necessary regulations for the enforcement of these ordinances are published by the Imperial Chancellor with the advice of the marine and commercial committees of the Imperial Council.

ART. 38. The alterations of the ordinance of June 20, 1888 (Imperial Legal Bull., p. 190), contained in this enactment take effect on July 1, 1895. However, the measuring can be done according to the revised ordinances after April 1, 1895.

ART. 39. The certificates issued before January 1, 1889, become void on January 1, 1900.

Those issued from January 1, 1889, to July 1, 1895, still retain their validity.

The certificates issued from July 1, 1895, to January 1, 1900, conforming with article 17, paragraph 1, of the ordinance of June 20, 1888, regarding the custom in foreign ports of deducting the cubic contents of the engine and fuel compartments according to British rules are held to be valid in German ports.

NOTES.

1.

The maritime statutes of June 22, 1899, and of May 29, 1901, concerning the nationality of merchant vessels, apply to:

(1) Ships (merchantmen) which make ocean trips for commercial purposes, including pilot boats, deep-sea fishermen, salvage boats, and tugs. (Art. 1, statute of June 22, 1899.)

(2) Seagoing pleasure yachts, vessels (training ships) used exclusively for the training of seamen; also to such native-built boats as are constructed for foreign States or their citizens. If, however, such boats make use of the right to carry the imperial flag, they must conform to the authorized rules for merchantmen.

By imperial enactment given with the consent of the Imperial Diet the statute of June 22, 1899, may extend to other vessels not commercially engaged in ocean voyages. It also applies to lake boats which trade exclusively in foreign waters. (Arts. 26 and 26a of the statute of May 29, 1901.)

2.

A "sea voyage" in the sense of article 1 of the statute of June 22, 1899, is considered to be a voyage in the following established districts:

(The determination of the boundaries for the protective district of all voyages is left to the chancellor or to officers authorized by him. Seventeen districts are at present defined.)

3.

Regulation of July 2, 1905, concerning the sleeping, wash, bath, and toilet rooms for the crews on merchant ships. According to article 56, paragraph 2, of the Marine Ordinance of June 2, 1902 (Imperial Legal Bull., p. 175), the imperial council has enacted the following rules concerning the size and arrangement of the sleeping rooms and the arrangement of the wash, bath, and toilet rooms for the crew.

SIZE AND ARRANGEMENT OF THE SLEEPING ROOM FOR THE CREW.

ART. 1. For merchant ships of more than 400 cubic meters gross tonnage, with the exclusion of deep-sea fishing vessels, the following rules govern:

1. The size of the sleeping rooms must be so apportioned that for each person accommodated therein there will be an air space of at least 3.5 cubic meters. In the rooms which lie on the upper deck or have good ventilation an air space of at least 3 cubic meters is required for each sailor. By "air space" is meant the cubic contents after the deduction of the structural parts of the ship which are contained in the sleeping room.

There must be at least 1.5 square meters floor space in each sleeping room for every person quartered therein. This floor space can be decreased to 1.25 square meters if a special eating

place is furnished for the occupants of these rooms. In figuring the surface it is only necessary to measure to the inner edge of the frame. In sleeping rooms sloping outward at the top the estimate is based on the middle horizontal section of the room.

2. The average clear height of the cabin must be at least 2 meters, and in ships of not more than 2,000 cubic meters gross tonnage at least 1.8 meters.

3. The cabin must be effectively protected against dampness, foul odors, the heat of neighboring rooms, and other offensive agents.

4. Entrances leading to the freight hold must not lead through the sleeping rooms. Provision rooms, with the exception of the cable hole, must not be entered through the sleeping rooms during the night except in case of necessity.

5. A sufficient amount of daylight must enter each sleeping room. In cloudy weather and at night it must be sufficiently illuminated by artificial means.

6. The middle of the sleeping rooms must be completely free of shafts, tunnels, ventilating pipes and other conduits.

7. The floor of the sleeping rooms must be finished in wood or be furnished with a thick covering which can be easily cleansed, and which is a nonconductor of heat. The walls and decks of the sleeping rooms must be coated with a bright oil paint; iron ceilings must be covered with a protective coating for the prevention of condensation.

8. One bunk for his individual use is allowed each sailor. Double bunks without partition walls are not permitted. The length of a bunk can not be less than 1.83 meters, the width not less than 0.6 meters.

The distance between the floor and the lower bunk must be at least 25 centimeters. It can be reduced to 15 centimeters when three bunks lie over each other, are made of iron, and can easily be removed. The distance between each two bunks located above each other and the distance between the bottom of the upper bunk and the ceiling of the sleeping room must amount to at least 75 centimeters. More than three bunks located over each other are not permitted.

The bedding must frequently be thoroughly aired and cleaned, and disinfected when necessary.

9. Besides the natural ventilation through the windows and doors, devices must be provided in each sleeping room, by which a sufficient renewal and circulation of the air is made possible. If fans are provided their lower end may not be so placed that a cold current of air shall strike directly upon the berths.

10. In cold weather care must be taken to heat the sleeping rooms sufficiently. Iron stoves should be surrounded with iron castings which must be at least 5 centimeters from the stove, and provided at the base with several large openings.

The stoves may not be furnished with movable lids or the chimneys nor the stovepipes be equipped with dampers.

11. The furnishings of the quarters with tables, benches, cupboards, and similar furniture must correspond to reasonable requirements. Each cabin must be provided with tables and have sufficient seating capacity for at least half the persons quartered there, unless there is existing, and accessible to the sleeping rooms, a special eating room or other place which can be occupied at meal times. At least one cuspidor must be placed in each cabin and be daily cleaned.

12. Over the door of each stateroom must plainly appear the permissible number of occupants.

13. The staterooms must be kept clean.

ART. 2. On merchant ships if not more than 400 cubic meters gross tonnage, and likewise on all deep sea-fishing vessels, the quarters for the crew, as required in article 55, paragraph 1, of the marine ordinance (see the conclusion of No. 3) should be as well taken care of as possible.

ARRANGEMENT OF THE WASH AND BATH ROOMS FOR THE CREW.

ART. 3. On all merchant ships every facility must be furnished the crew for washing clothes and for personal cleanliness.

ART. 4. On all steamships, on which the crew numbers more than 20, there must be at least one bright, clean wash room, furnished with bathing facilities at least sufficient for every second man of one watch, provided there are no special accommodations for individual members of the crew. The wash rooms must have heating facilities. However, this rule can be waived on freight boats which are not furnished with steam heat.

The washing facilities can be situated in the toilet rooms, provided arrangements for the preservation of property and for the cleansing of the bowls are made.

ART. 5. There must be a special wash room for the engine-room force if they number over 10 persons, and must be so located that it can be reached on the way from the stokehold and coal bins before the quarters are entered. These wash rooms must be so large that at least one-sixth of the engine-room force can wash there at one time. They must be furnished with sufficient plumbing and shower baths (one for every four persons who wash at the same time) and with a sufficient number of washbasins.

Furthermore, an arrangement for the drawing of warm water must be provided in these wash rooms.

ART. 6. On all steamers which have warm shower baths for passengers, such comforts also must be provided for the crew; at the same time precaution must be taken to prevent the bather from being scalded.

ART. 7. On steamers bound on a more or less extended voyage fresh water for bathing must be provided for the use of the crew at least twice each week. Deep sea-fishing vessels bound on voyages in northern European waters are exempted from this rule.

ART. 8. The wash and bath rooms must be cleaned daily.

ARRANGEMENT OF TOILET ROOMS FOR THE CREW.

ART. 9. On merchant ships, with the exception of sailing ships, of not more than 400 cubic meters gross tonnage, the toilet conveniences must be located in separate rooms; the urinals may be placed in the toilet rooms. On ocean lighters a well-built toilet closet will suffice.

If the number of deck hands exceeds 10, a special toilet room is provided.

ART. 10. The toilet rooms must be at such an elevation that the seats are above water. They must be separated from the adjoining sleeping rooms by one or more rooms or at least by an odor-proof bulkhead without doors.

They must be provided with an effective ventilating system and with sufficient light. Ceilings and walls must be painted with a coat of bright oil paint. The floor must be so constructed that it is impervious to air and water.

ART. 11. The toilet must be furnished with such a number of 50 centimeter wide seats that for a crew of not more than 100 there will be at least 1 seat for every 25, and for a crew of from 1 to 200 an additional seat for each 33 men. And for a crew of more than 200 at least 1 seat for every 50 additional men.

The seats can be dispensed with in the case of non-European crews who are not accustomed to their use.

ART. 12. On sailing ships of not more than 400 cubic meters gross tonnage, there must be one removable seat.

ART. 13. The toilets and urinals must be cleaned daily.

GENERAL REGULATIONS.

ART. 14. The rules contained in articles numbered 1, 2, 4, 5, sentence 1, and those regarding the use of bunks and the measure of the dimensions according to the calculation of article 1, No. 8, and the rules contained in articles 4 to 6, article 9, paragraph 2, article 10, paragraph 1,

and article 11, paragraph 1, hold good only for ships which were commissioned after October 1, 1905.

ART. 15. The owner is responsible for the prescribed construction of the rooms and arrangements provided for in these stipulations, and the master for their prescribed management and use.

ART. 16. The plans, arrangement, and repair of the sleeping, wash, and bath rooms and of the toilets for the crew are subject, while in German ports, to regular inspection by the boards appointed by the State government.

ART. 17. The Imperial Chancellor is empowered, acting in concert with the State government, to permit exceptions to the foregoing rules.

ART. 18. These rules take effect on January 1, 1906. Article 55, section 1, of the seamen's ordinance of June 2, 1902, reads as follows:

> From the time their service starts until they are discharged, the crew can claim one well-kept and ventilated sleeping room intended for them and their use only, provided the termination of their term of service does not delay the journey. The room corresponds to the size of the crew and of the boat.

4.

Ships of not more than 50 cubic meters gross tonnage, though not registered and without a certificate, still have the right to fly the imperial flag. (Art. 16 of the statute, concerning the nationality of merchant ships of June 22, 1899.)

5.

A ship's register must be kept by the delegated authorities for the merchant ships authorized to carry the flag of the Empire, whether they are at sea or in port.

The ship's registers are kept by the district courts. By order of the judicial administration of the State, the ship's registers for several judicial districts may be kept by one district court. (Art. 4 of the statute, concerning the nationality of merchant ships of June 22, 1899.)

APPENDIX VI.

SHIP MEASUREMENT INSTRUCTIONS ISSUED BY THE GERMAN GOVERNMENT MARCH 26, 1895.

APPENDIX VI.

SHIP MEASUREMENT INSTRUCTIONS ISSUED BY THE GERMAN GOVERNMENT MARCH 26, 1895.[1]

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[1] Translated from the German by First Lieut. H. O. Olson, Eighteenth Infantry, United States Army.

I.—*The measuring instruments.*

ARTICLE 1. The following instruments are used for purposes of measurement:

(1) Two 3-meter rods, with solid brass shoes at each end. Also three steel implements, which can be screwed to the ends of the rods, namely:

(*a*) A steel implement for the fastening of the ring of a plumb line or the ring of a tapeline.

(*b*) A steel implement for the clasping of a plumb line or a tapeline.

(*c*) A steel implement with two short points, for the setting up of the meter rod in measuring breadths.

(2) Two 2-meter rods, like those described under No. 1; of these, one should have a beveled brass shoe at one end.

(3) One 2-meter rod, each end provided with a solid brass shoe, and one end with a firm thinner rod that telescopes. The apparatus has, when the sliding rod is entirely extended, a length of 3.8 meters.

(4) One 1-meter rod, like the one described under No. 3, with the telescope rod attachment (up to 1.9 meters length).

(5) One 1-meter rod, folding hinged, and in the middle as well as at each end fitted with brass mountings.

(6) A tapeline, 15 to 20 millimeters wide, and 20 meters long, fitted to roll up around a cylinder, and at one end provided with a brass ring, the beginning point of the linear measurement division lying at the outer edge of the ring. If, in case of the larger ships, a length of 20 meters will not suffice, a tapeline of 25 or even 30 meters in length is employed. In case of the smaller ships a tapeline of 15 meters may be used.

(7) A gunters chain of galvanized iron, provided with a tag at every 10-meter interval, and a thin line 3 meters long at each end. This chain is 30 meters long.

(8) A steel square, on the outer edge of each leg of which is constructed a linear measurement of 20-centimeter divisions, so arranged that the beginning point of each lies at the outer point of the right angle of the square.

(9) A line of from 15 to 20 millimeters circumference and 50 meters long, provided with means for rolling up.

(10) Two lines of from 8 to 10 millimeters circumference and 25 meters long, each provided with a plummet bob and a contrivance for rolling up. On each line at about 0.2 meter from the plummet bob a brass ring is fastened.

(11) An attachment by which, in case of need, the two rods described under sections 1 to 4 can be joined together.

(12) A brass roller, in addition to an iron weight of 2.5 kilograms, with hooks, for testing the tape described under No. 6.

(13) A steel meterstick with calculations for the testing of the linear measurements.

ART. 2. The measuring instruments described in article 1, under Nos. 1 to 8 and 13, are to be tested by the imperial standard gauge commission and the date of the test stamped on the instruments.

ART. 3. Each measurement board (art. 21 of the ship measurement ordinance), as well as each official intrusted with the preparation of measurement certificates (art. 24, par. 4, of the ship measurement ordinance), must be provided with at least one set of the instruments described in article 1.

The approved measuring instruments of the last-mentioned officials shall be accepted as standard.

ART. 4. The officials mentioned in article 24, paragraph 4 of the ship measurement ordinance have, as one of their duties, according to paragraph 5 of the same article, the official testing and correcting of all the measuring instruments used by the measurement boards, at least once a year, according to test specimens.

In the instruments mentioned in article 1, under 1 to 7, no greater deviation from accuracy when in use should be allowed than the following:

In No. 1, the greatest permissible deviation for the entire length	3	millimeters.
In No. 2, the greatest permissible deviation for the entire length	2	millimeters.
In No. 3, the greatest permissible deviation for the entire length, rod not extended	2	millimeters.
Extension rod	2	millimeters.
In No. 4, the greatest permissible deviation for the entire length, rod not extended	1.5	millimeters.
Extension rod	1.5	millimeters.
In No. 5, the greatest permissible deviation for the entire length	1.5	millimeters.
In No. 6, the greatest permissible deviation for each meter in the division	5	millimeters.
In No. 7, the greatest permissible deviation for the entire length	10	centimeters.

When the aforementioned measuring instruments come to have a greater deviation than that authorized, their use shall be immediately discontinued and before again being used they shall be restamped (art. 2).

ART. 5. At regular intervals, at least once every quarter, the measurement boards will test the meter rods (art. 1, Nos. 1 to 5) by means of the steel meter measure with the valuations (art. 1, No. 13), and the tapeline and chain (art. 1, Nos. 6 and 7) by means of the meter rod.

The testing of the 3-meter rod by means of the steel stand ardmeter measures hall be as follows: One places first one, then the other end, of the 3-meter rod against the scale of the meter measure, then reads off from the meter measure the variation in millimeters of the nearest or next meter mark from the end of the meter measure, and then compares the length of the middle meter interval (of the 3-meter rod) likewise with the length of the meter measure, this being so done that one places the 3-meter rod along that side of the meter measure on which there is no scale but opposite to or corresponding with the face of the meter measure across which the lines of the scale are drawn. The sum of the errors of the 3-meter intervals gives the total error of the meter stick. The test of the 2-meter and 1-meter sticks follows under the proper application of the foregoing rules.

The testing of the tapeline is performed as follows: With a screw clamp, one end of the tape is fastened to a rigid object and then a suitable distance is unwound and fastened to another clamp connected with the brass roll and weight piece (art. 1, No. 12); when the tape is sufficiently tight, the steel meter measure is applied and it is determined whether the meter lengths of the tape do or do not exceed the permissible deviation (art. 4, sec. 2, and art. 1, No. 13).

The testing of the chain is performed by stretching it along an even level surface and measuring it by the tested meter rod, as given under section 2 of this article.

All measuring instruments found by this test to be inaccurate will be disposed of as directed in article 4, paragraph 3.

II.—*General regulations.*

ART. 6. The measurements to be determined are rounded off to centimeters in such a way that the fraction of one-half or more is reckoned as a whole centimeter, but a fraction smaller than one-half is disregarded.

ART. 7. The measurements are, after they are accepted, entered in the measurement forms in such a way that fractional meters are entered after the number of whole meters as decimals (i. e., 10.75 m., 0.6 m.).

ART. 8. If a length, breadth, height, or depth of the spaces described in the ship measurement ordinance strikes projecting plank works, knee timbers, or similar projecting parts, that measure is taken which would result if at the point in question the projecting part of the interior planking or deck surface did not exist, and such interior planking or deck surface were of the same thickness as that which prevails between the points to be measured on the interior planking or deck.

ART. 9. By interior planking is meant only such coating as is fixed firmly or enduringly in the framework of the ship or to the ship's double bottom, but is not such as is designed for the protection of the separately constructed parts of the ship or for the temporary protection of the cargo. A durable, fixed lathing is to be considered as interior planking only in case the distance between the single laths is not more than 0.3 meters.

In every case, therefore, before taking the measurement, it must be determined how far the interior planking conforms to the foregoing demands. (See fig. 9.)[1]

If after such investigation no such interior planking is found to exist, the measure must be taken to the interior surface of the beams or their vanishing lines, respectively, to the upper surface of the double bottom; if no beams are present, then the measure must extend up to the inner surface of the exterior planking or its vanishing line.

ART. 10. As the mean length, breadth, height, or depth of a limited space bounded by straight surfaces, the arithmetical means of at least 3 consecutively obtained measurements is taken.

ART. 11. In the meaning of article 4 of the ship measurement ordinance, only such are deemed decks as run continuously from aft forward and whose beams are rigidly attached to the framework of the ship's body and durably covered. Openings or bulkheads for engine and boiler rooms, as well as hatchways, are not regarded as interruptions in the deck.

Breaks, even when the entire breadth of the ship is taken, are not considered if they do not equal half the length of the deck concerned. If the amount of the deeper lying part of the deck exceeds half the length of the deck, the part up to the base line will be regarded as deck. (See figs. 1 and 2.)

ART. 12. Uncovered breaks arising from breaks in the tonnage deck should be measured separately and their extent deducted from the ascertained material contents of the space under the tonnage deck. (See fig. 21.)

ART. 13. If the ship has structures of the nature considered in article 13Bb of the ship measurement ordinance, such structures may, upon application of the ship owners or shipbuilders to the bureau of registry, be excluded by the measurement boards from the gross tonnage, in which case a full explanation of all essential points bearing on the case, as well as a sketch of the structures, their mode of attachment, etc., will be submitted.

ART. 14. Spaces intended to contain rudders, capstans, anchor-raising apparatus, etc., when on or above the upper deck, are not surveyed as a part of the gross tonnage (art. 13Ba, ship measurement ordinance), and thus are not deducted from the gross tonnage. If, on the other hand, such spaces are located below the upper deck, their contents will be deducted from the gross tonnage. (See art. 14A3a, ship measurement ordinance.)

Rooms intended for the safekeeping of charts, signal apparatus, and navigation instruments, as well as boatswains' supplies, are, regardless of their location, always calculated as part of the gross tonnage, but are also deducted in every case. (Art. 14A3b, ship measurement ordinance.)

Auxiliary engines and boilers located inside of the engine and boiler rooms, and connected with the main engine and serving as means of propulsion to the ship, are, from the nature of their location, considered part of the main engine and boiler rooms, numbered with them, and not separately deducted from the gross tonnage. If the auxiliary boiler is located in a closed structure on or above the deck (upper), the contents of these structures is not, according to article 13Bb of the ship measurement ordinance, measured as part of the gross tonnage, and consequently are likewise not deducted. In all other cases in which the requirements of article 14A4 of the ship measurement ordinance are fulfilled, all auxiliary-boiler room spaces included in gross tonnage are again deducted.

ART. 15. In the meaning of article 20 of the ship measurement ordinance, open vessels are considered to be such craft as are only partly covered and the cargo rooms of which are not closed by hatches.

[1] See figures at end of this appendix.

ART. 16. In the meaning of the ship measurement ordinance, the engine room is meant to include not only the space for the engine itself, but also all spaces occupied by apparatus for the generation of propelling power (boilers, etc.).

If the engine room is not inclosed by two bulkheads, then, in measuring the length of the room, it should include the space intended for the absent bulkhead necessary to bring the engine room up to an efficient inclosing. This space is to be ascertained in each individual case, and its position clearly defined on the surface curve. (See art. 28.)

In the measurement of the engine room, as well as in the computation of the gross tonnage of the ship and of deductions from the same, the following rules will be observed:

(1) The gross tonnage of the ship is ascertained without reference to the engine room; the measurement of the latter should then be undertaken independently of the other.

(2) A measurement of the engine room is, under all circumstances required, even when the deduction from gross tonnage is a percentage of the latter, as the method of computing the deduction depends upon the size of the engine room.

(3) In the execution of the measurement the following points should always be observed:

In ascertaining the depth it is either the distance from the highest point on the under surface of the deck directly over the engine room, or in case the walls of the engine room are curved, from a point in the horizontal plane passing through the point at which the curvature ends.

In finding the length of the engine room proper, it is only necessary to measure and consider the portion actually occupied by the engine and boilers. In case firing is done from a longitudinal direction of the ship, an additional space is required for the handling of stoking tools. In such case a distance of about 30 centimeters in addition to the actual firing grates is considered sufficient.

If the stoking and firing are done cross ships, this additional distance is not required. In this case, the room between the boilers will serve for stoking facilities, and should be measured as about 3.5 meters in the room space of the engine room. (See Appendix 7 in this report, "Technical directions," Art. VII.)

(4) If the engine room has an irregular form, it must be divided into parts, and each part measured separately.

While the cubical contents of the engine room is ascertained by the previously described method, in order to fix the authorized deductions from the gross tonnage of the ship, the contents of any cabin or store rooms located within the engine room itself must be ascertained and deducted from the total contents of the engine room.

III.—Obtaining the measurements.

(*a*) MEASURING THE LENGTH OF THE TONNAGE DECK.

ART. 17. The measuring of the distances between the points described in article 6, paragraph 1, of the ship-measurement ordinance, is executed in the following manner:

The 50-meter line is stretched taut from aft forward, as near as possible to the median line of the ship, parallel to the chord of the arc of the tonnage deck, and at such distance above the deck as to be free from all obstructions and still allow a convenient measuring.

The points between which the length is to be measured are ascertained by the aid of a plummet or a T square, or are in some other convenient manner projected upon the line.

If the line is stretched taut, the measuring is done with the meter rods described in article 1, Nos. 1 and 2, while the meter rods are interchangeably applied from one end of the line to the other, and in such a way that the first rod and the line are clasped in both hands while the other rod is applied along the line so as to touch the end of the first rod. After the second rod is firmly clasped to the line, the first rod is removed and applied beyond the second, and in this manner the measuring is continued to the end of the line.

If, on account of superstructures or other obstacles, it is impracticable to stretch out the line in the manner described above, or the line, on account of the great length of the ship, is not

long enough, the entire length must be divided into sections and each part measured separately. In this way the use of the line can be dispensed with and the measuring on the deck itself can be continued by means of the measuring staff and the tape, respectively.

It is to be observed that the use of the plumb line in placing the end of the tape directly above the points on the deck can be accurate only when the ship lies at an even or almost even keel. If this is not the case, as for example when the ship is lying in the stocks, then the projection must be done by means of the T square, or must follow in some other convenient manner. (See fig. 4.)

In order to determine the location of the forward end point for making the proper deductions for the rake of the bow in the thickness of the deck, the following must be ascertained:

The meter rod described in article 1, under 5, is placed so that one leg rests on the upper surface of the upper deck and the other leg as nearly as possible is held parallel to the inner surface of the bow. The angle thus formed (ABC) is marked with chalk on the deck surface, and then above the line BC the measure of the thickness of the deck is set off and through the obtained point parallel to BC the line DE is drawn. If at the vertex B, a right angle be set off, the resulting line DF will be the deduction to be made for the rake of the bow in the thickness of the deck. (See fig. 8.)

In a similar way, in case of ships with rounded sterns, by determining the aft end point, the required deduction which arises from the rake of the sternpost can be ascertained (where no such post exists, at the middle of the stern). In regard to ships with flat sterns, the rake of the sternpost in one-third of the deck-beam arch will be deducted. (See fig. 7.)

If, at the terminal points of the length, there are superstructures on the tonnage deck, the length of the latter may be ascertained either by measuring through the superstructures, or, if this can not be done, by going above them. In the latter case, points are to be determined which lie directly above the terminal points and at right angles to the plane of the keel. The location of these points must be determined by the use of two measuring rods and the T square (Art. 1, Nos. 1 and 8) applied to the vertical height of the superstructure and the angle of inclination of the stern or of the bow, in the same way as in figure 4 and in figure 20.

(*b*) DETERMINING THE POSITION OF THE CROSS SECTION BELOW DECKS.

ART. 18. After the length of the tonnage deck has been measured in conformity with the methods of article 17, the half length of the deck is laid off from the aft end forward and thus the middle point of the length is established. A check is established by laying off the half length of the line from the forward end aft; in case this does not coincide with the first established middle point, the entire length as well as each half must be remeasured (art. 17, secs. 4 and 5) as often as necessary until the exact middle point is established.

Through the middle point of the line thus established a line is drawn at right angles to the keelson and this will determine the position of the middle cross section. In projecting this the edge of the balk can be used as support.

If the middle point of the length does not fall opposite an opening in the deck, so that it can not be projected directly to the room below, another point on the line, situated opposite an opening in the deck, is chosen, and the line is projected down to the floor of the next deck, proper ordinates being set off for the location on this deck of the middle cross section.

From the determined point the remaining parts mentioned in article 6, paragraph 3, of the ship-measurement ordinance, are laid off on the floor plates, in straight lines from the keelson, forward and aft, and the positions of the other cross sections are similarly determined. (See fig. 23.)

The determined cross-section points shall be numbered in conformity with the requirements of article 8, paragraph 3, of the ship-measurement ordinance, in which connection it is to be observed that in craft of unusual shape, as barges, scows, etc., the cross sections at the forward and aft terminal points can be located on the surface only.

In case of interruptions in the double bottom (Art. 7, par. 3, of the ship-measurement ordinance), or changeable height of the same, the measurement of the ship below the tonnage deck is accomplished by dividing it into separate sections corresponding to a uniform height of the double bottom. The length of each of these parts of the ship is again divided into an equal number of parts and these measured, as prescribed in article 6 of the ship-measurement ordinance.

(*c*) MEASURING THE DEPTH OF THE CROSS SECTIONS UNDER THE TONNAGE DECK.

ART. 19. The measuring of the depth is performed by means of the meter rods described in article 1, Nos. 1 to 4, which rods can, when necessary, be joined together. (Art. 1, No. 11.)

First of all the entire depth is to be measured, from the undersurface of the tonnage deck to the uppersurface of the bottom transom on the inner side of the passageway, or up to the uppersurface of the inner double bottom, at right angles to the horizontal and parallel to the vertical plane of the keel.

If the lining can not be removed then the measure of the depth can be taken up to the uppersurface of the inner lining below the keelson or, in case this does not give the greatest depth of the cross section, up to the inner lining on whatever side the depth of the cross section is the greatest. (Compare figs. 9 to 11.)

If there is a deck through which the depths must be ascertained, then they must be taken piecemeal, by measuring from the undersurface of the tonnage deck to the upper surface of the intervening deck, and from the undersurface of this to the deepest point as above determined. The sum of the two measurements augmented by the thickness of the intervening deck is, in this case, the depth sought. Proceed in a similar way if under this second deck there are several half decks, platforms, etc. (Compare fig. 12.)

If on a raised platform in the under portion of the ship there is still a covering, the thickness of this can be ascertained from the measured depth.

If the depth falls in an opening in the deck, then it is marked on the nearest convenient place, either on the forward or aft side of the opening, due consideration being given the vanishing line of the deck.

(*d*) DETERMINING THE CURVATURE OF THE DECK BEAM UNDER THE TONNAGE DECK.

ART. 20. The deck-beam curvature should be ascertained at each of the measured cross sections. In order to determine the exact curvature the line described in article 1, No. 10, must be held at that place on each cross section, where the undersurface of the deck intersects with the inner surface of the inner planking. Thereupon the line must be stretched taut to the corresponding point on the other side of the ship; the vertical distance of the cross line from the undersurface of the tonnage deck in the middle of the cross section is then the measure for the deck-beam curvature and can be taken by means of one of the meter rods described in article 1 under 3, 4, and 5.

If the above-described point can not be reached with the hand, the ring of one of the plummet lines described in article 1, No. 10, should be fastened to the end of the aforementioned meter rod by means of its steel attachment (art. 1, Nos. 1 and 2) and the end of the rod placed at the point marked; then the plummet line should be fastened in the groove of the other meter rod with its steel attachment, and the end of the rod likewise placed at the point marked at the other side of the cross section, and the line held taut so that it forms a straight line. The vertical distance of the taut line from the undersurface of the surveying deck is then, as above, the measure of the beam curvature.

In case hatches or framework under the deck planks prevent the stretching of the cord in a straight line at the place in the cross section referred to, the determining of the deck-beam curvature must be made beyond the cross section, far enough either forward or aft, to permit the stretching of the cord in a straight line.

If the determining of the deck-beam curvature can not be made under the deck, as above described, it is done above the cross section on the deck in such a manner that one of the plummet lines (art. 1, No. 10) is stretched across the deck and the vertical distance of this line from the deck surface is measured in the middle of the ship as well as at one side of the deck. The difference in the two distances for decks without protruding fish shows the deck-beam curvature. For decks with protruding fish, it will be necessary to add to the distance of the line from the deck surface, at the middle of the ship, the projection of the fishes.

(*e*) MEASURING THE BREADTH OF THE CROSS SECTION UNDER THE TONNAGE DECK.

ART. 21. The breadth is measured by means of the tape or the meter rod. To measure the breadth of the cross section a meter rod is erected at the middle or as near as possible to the middle of the cross section and parallel to the longitudinal plane, so that the under end of the rod touches the bottom of the ship and the upper end the tonnage deck, and on the rod thus placed there are marked off the division points into which it has been separated in calculating the depth of the cross section according to the regulations in article 7, paragraphs 4 to 6 of the ship measurement ordinance (compare fig. 10). If the tonnage deck is not the lowest deck of the ship, and if the depth does not strike an opening in the intervening deck, then in the prolongation of the rod placed between the bottom of the ship and the under deck a second rod will be erected between this deck and the tonnage deck and both of them divided in the manner described above (compare fig. 12). Through these division points the breadth measure is then laid off at right angles to the longitudinal plane of the ship.

In ships having no between-deck beams and in which, for this reason, it is difficult to reach the terminal points of the upper breadth with the hand, the measuring is thus performed: The tape is laid over the steel rods with which the meter rods are provided and the steel rods are placed at the end points of the breadth; then the tape is drawn taut, the loose end of it laid on the rod and across this and the tape a chalk mark is made; after that the tape and the steel rods are taken down and the length of the tape between the above-mentioned rods is read. In case the tape should be displaced during the taking down, its length may be corrected with reference to the chalk line, after which the reading may continue.

The breadth to be measured through the upper end point of the depth at a distance of one-third of the deck-beam curvature under the tonnage deck can not be taken at that point, because its direction, at right angles to the vertical plane of the keel, as a rule, extends through the deck. This breadth of the cross section is therefore to be ascertained at another nearby point in the cross section, to which the tape can be tightly stretched in a straight line, and the required deductions or additions can be made upward on the inner surface of the inner planking.

The breadth to be measured through the lower end of the depth is in every case the breadth of the floor, so far as the floor is in a straight line or is flat. In ships with entirely flat bottoms the whole breadth of the flat bottom must be taken (compare fig. 24), and in ships with rounded bottoms the breadth between the points on the bottom where the slope in the surface begins to change (compare figs. 10 and 12).

In regard to ships with double bottoms, in which the inner bottom rises toward the sides, the surface area of the descending cross section in the region of such double bottoms can be estimated as follows:

If the depth of the cross section laid through the middle division point of the length does not amount to more than 5 meters, the depth of each of the cross sections will be divided into five equal parts. The inner breadth of each cross section, at right angles to the longitudinal plane up to the inner vanishing line of the interior lining, will then be measured through each of the four middle division points as well as through the upper end point of the depth. If these breadths, taken from the upper row, are designated as 1, 2, 3, etc., the second and the fourth breadths are multiplied by 4, and the third by 2, and the products are added to the sum of the first and fifth breadths. This number is multiplied by the third part of the common differences

of the breadths. The product represents the surface area of the upper part of the cross section. To find the surface area of the lower part of the cross section located between the fifth and the lowest division point of the depth of the cross section, the distance between the two division points is to be divided into four equal parts. The required breadths are to be measured at these division points.

The computation of the lower surface part is made in the manner prescribed in article 7, paragraph 5, of the ship measurement ordinance. The sum of both surface areas represents the contents of the whole cross section.

If the depth through the middle point of the length of a cross section is more than 5 meters, the depth of each cross section is divided into seven instead of five equal parts. Accordingly, there are now six middle and upper breadths to be measured. If these breadths from the top row down are designated as 1, 2, 3, etc., then the second, fourth, and sixth breadths are multiplied by 4, the third and fifth by 2, and to the sum of these products the sum of the first and seventh breadths is added. The total sum is multiplied by one-third of the total distance of the breadths from each other and the product represents the surface area of the upper part of the cross section. The surface area of the lower part is obtained in the manner just described. The sum of both surface areas is therefore the contents of the entire cross section.

If a deck beam is located at the point where the measuring of a breadth should occur, the measuring is done at the nearest convenient point, forward or aft, of the deck beam.

If the measuring of a single breadth is obstructed by the bulkhead or binding timbers at the designated place, the measuring of the breadth can be similarly performed at another point as near as possible to the given point. In such a case a correction of the obtained measure must be made in accordance with the form of the ship.

If the measuring of the breadth is obstructed by a longitudinal bulkhead in the median line of the ship the division points of the depth in which the breadth should have been measured will be set off on both sides of the bulkhead. From each of these division points the breadth is set off, by measure, toward each side and at right angles to the bulkhead. The sum of both measurements, augmented by the thickness of the bulkhead, gives in such case the total breadth of the cross section within the division points referred to.

If a breadth is to be measured through an intervening space bounded by lathing, which in article 9 is regarded as permanent inner planking, the measure must be taken to the inner vanishing line of the lathing. (Compare fig. 9.)

(*f*) MEASUREMENT OF BETWEEN-DECK SPACE ABOVE THE TONNAGE DECK.

ART. 22. The inner length of between-deck spaces will be ascertained in the following manner:

At the points designated in article 6, paragraph 1, of the ship measurement ordinance (end points of the tonnage deck), the meter rod is placed in such a way that its under end rests on the tonnage deck, and its upper end touches the under surface of the deck above. From the fore and aft edges, respectively, of the meter rod the distance is measured to the inner surface near the bow and to the inner surface of the rib covering at the stern, at right angles to the meter rod. (Compare fig. 3.)

The sum of these distances added to the length of the tonnage deck gives the total length of the between-deck space at half height.

This length will be divided into such a number of equal parts as is prescribed in article 6 of the ship measurement ordinance with reference to the length of the tonnage deck. At each of these division points the height and breadth are measured according to the ship measurement ordinance.

(*g*) MEASURING OF SUPERSTRUCTURES AND OF SPACES TO BE DEDUCTED FROM GROSS TONNAGE.

ART. 23. Whether a permanently fixed superstructure on the upper deck is or is not to be surveyed will be determined according to the provisions of article 13 of the ship measurement ordinance.

If the interior arrangements of the superstructure do not permit the taking of the measurements on the inner side, the same are taken on the outside, due deductions being made for the thickness of walls and cover.

In the case of permanently fixed superstructures in the form of raised hatchways or partitions, which connect with spaces below decks, the measurement of their heights is taken from the under surface of the hatchway cover to the under deck surface, or to the corresponding surface of the space below decks. For the mean height of these spaces the arithmetical mean of the heights at the middle and one end of the hatchway sill will be taken. (Compare fig. 18.)

Superstructures of irregular form or such form as will not enable the surveyor to ascertain their contents in one operation will be divided into divisions and each division measured separately. (Compare figs. 13 to 16.)

(*h*) MEASURING BY THE ABBREVIATED METHOD.

ART. 24. In measuring the length of the ship between the points mentioned in article 18, paragraph 1, of the ship measurement ordinance, the process prescribed for obtaining the length of the tonnage deck (art. 17) will be followed.

In order to measure the greatest breadth of the ship both plummet lines are so hung along the outside of the boards that their perpendicularly stretched cords touch the outer surface of the exterior covering or the wales at opposite points of a cross section of the ship. The normal distance between the lines, which is measured either with the tape (art. 1, No. 6) or with the meter rod (art. 1, No. 1), gives a breadth of the ship. This method of obtaining the breadth of the ship is used for the remaining cross sections of the ship and is retained as long as the result of the measuring is of equal or greater value. The greatest result thus obtained is then the ascertained greatest breadth of the ship. For this measuring, if the ship has a list, it must be brought to an even keel by removing the cargo.

The perimeter of the ship at the outer surface of the exterior covering will be ascertained by means of the chain, described in article 1, No. 7, and the meter rods (art. 1, Nos. 1 to 5), according to the instructions in article 18, paragraph 2, of the ship measurement ordinance.

(*i*) MEASURING THE STANDARD DIMENSIONS.

ART. 25. The measuring of the length of a ship between the points designated in article 25, 1a and 2a of the ship measurement ordinance (compare figs. 5 and 6) is proceeded with in the same manner as in obtaining the length of the tonnage deck. (Art. 17.)

The measuring of the breadth between the points designated in article 25, 1b of the ship measurement ordinance, is performed with the meter rod referred to in article 1, 1 to 4 (compare fig. 12), the meter rod being applied at right angles to the longitudinal plane of the ship.

The measuring of the depth is proceeded with in a manner similar to that of obtaining the depth of the cross section (art. 19). (Compare figs. 10 and 12.)

If a lowered cabin is located in the middle of the length, two depths are measured, one to the under edge of the lowered deck, the other to the under edge of the cabin roof. In such cases both depths, each in fractional form, will be entered in the measurement certificate as well as in the measurement forms. (Compare figs. 1 and 2.)

IV.—*Calculating the tonnage.*

ART. 26. The making up of the measurement forms is done in accordance with the formulas given under D to G.

After all computations, drawings, etc., have been entered, each form should be countersigned by at least two members of the measurement board, including the shipbuilding engineer.

ART. 27. All calculations are carried out to the third decimal place, and when the fourth decimal is five or more the third is increased by 1.

ART. 28. As the check on the complete method in the foregoing measurements and computations of the under deck tonnage of a ship or of the gross tonnage of a vessel without decks the following-described drawings, to a convenient scale at least as small as centimeters, will be carefully entered in the measurement forms.

(*a*) CONSTRUCTION OF THE HALF CROSS-SECTION CURVES.

On the horizontal line for curve constructions in the measurement forms, the distance of the cross section is set off from the middle point of the line, so that the horizontal line represents the length of the tonnage deck with its division points.

The division points are numbered according to the numbers of their corresponding cross sections on board, and in each one a normal should be attained. From these normals the calculated depths of the respective cross sections are set off and agree in each case with the depths obtained on board. Through the division points of the depths thus obtained, half of the distance of the ascertained breadths of the cross sections is set off to the right from the normal and parallel to the horizontal line. The end points of the breadth of each cross section are then connected by a curved line, which line establishes the outer limit of the half cross section.

For the distance between cross sections (par. 1) the scale in the appendix of the register which corresponds to the entire length of the particular deck is to be selected, and this should be set off on the horizontal line. For the drawing of the cross section (par. 2) the scale is also to be selected from the appendix, and must be so large that half of the maximum breadth of the greatest cross section approaches, but does not exceed, the distance between the normals.

(*b*) CONSTRUCTION OF THE AREA CURVE FOR THE ENTIRE CROSS SECTION.

The computed numbers representing the surface of the cross section in square meters should be divided by 10 or some other suitable divisor, and the quotient, in linear measurement, set off on the normal constructed toward "a," which represents the middle line of the appertaining cross section. Thereafter the determined points should be connected by a curve.

If the course of the curves to "a" and "b" is irregular, or if the curves to "a" have a remarkable discrepancy, the figures and calculations are again tested, and if the error is not one of mathematical calculation, the measurements are repeated and a correction attained.

If the irregularity in the drawn curve is found to be due to unusual forms of the measured ship space, this fact will be entered in the measurement form, below the drawing, in the nature of a short description of the ship's unusual form.

In this drawing will also be entered:

(1) In red, the location of the solid bulkhead bordering on the engine room, as well as the distance of this bulkhead from the nearest cross section, which is the place from which the length of the engine room should be measured in case it is not inclosed by two solid bulkheads. (Art. 16, sec. 2.)

(2) In blue, in a similar manner, the location of the limiting bulkheads of the double bottoms.

ART. 29. The final entries to be made in the ship's measurement certificate, in cubic meters, will be so reduced that the first decimal is increased by 1 if the second decimal is 5 or more.

In converting cubic meters into British registry tons the result is reduced to two decimals by increasing the second by 1 when the third decimal is 5 or more.

V.—*Concluding regulations.*

ART. 30. If it should be found that certain directions herein contained are not applicable on account of the nature of construction, or that evidently erroneous results in the measurement would follow, the determination of the way in which the measurement should be conducted rests with the Bureau of Registry.

ART. 31. The ship measurement boards are required always to submit to the Bureau of Registry (art. 24, par. 3 of the ship measurement ordinance) a copy of the measurement forms with the exhaustive drawings, etc., as per article 31 of the ship measurement ordinance.

If, after the inspection of the drawings by the measurement boards, doubt should arise as to the manner of performing the measurement, the copies of the drawings, etc., in the office of the Bureau of Registry will be referred to for decision as to the method of measurement.

These drawings, as well as the measurement forms, from which the measurement certificates are later transcribed by the Bureau of Registry, are filed and kept by the latter bureau. A transcript of the measurement forms is retained by the measurement boards, and any alterations made in the main set of forms are always transmitted to the Bureau of Registry for entry on its copy.

ART. 32. The measurement certificates (art. 27, ship measurement ordinance) are executed in duplicate, and after being registered in the office of the register authorities (art. 24, par. 5, of the ship measurement ordinance), and by them entered in the ship's papers, one copy is furnished the shipowners or their deputies, and the other copy is retained by the issuing board. A certified copy, executed according to the proper form, is furnished by the issuing board free of charge to the register authorities for their files.

The measurement certificates should be executed in accordance with the specified forms A, B, C.

ART. 33. The records to be made by the boards intrusted with the execution of measurement certificates, according to article 29, ship measurement ordinance, should be made out in the form prescribed under H.

On the first of February of every year a transcript of these records should be submitted to the Bureau of Registry.

Berlin, March 26, 1895.

By the deputy to the Imperial Chancellor,

VON BOETTICHER

GERMAN MEASUREMENT CERTIFICATES FOR DECKED VESSELS (FORM A), FOR OPEN VESSELS (FORM B), AND FOR VESSELS MEASURED BY THE ABBREVIATED METHOD (FORM C).

FOR DECKED VESSELS. FORM A.

GERMAN EMPIRE.

Kind of vessel.	Name of vessel.	Distinctive signal.	Nationality home port.

SHIP'S MEASUREMENT CERTIFICATE.

DESCRIPTION OF VESSEL.

Builder	Character of upper deck	Shape of bow
Year built		Shape of stern
Place built	Number of water-tight transverse bulkheads	Number of funnels
Material	below and above the tonnage deck	Number of masts
Kind of construction	Number of water ballast tanks with hatches	Rigging
Number of decks	Planking	

STANDARD DIMENSIONS.

Meters.

1. Length of vessel from the rear face of the prowpost to the rear face of sternpost on the uppermost permanent deck (in vessels with patent rudder, measure to middle of rudder post).....
2. Greatest beam of vessel between outer surfaces of planking or of the wales.....
3. Depth of hold from lower surface of the upper permanent deck to the upper surface of lower transoms next to the keelson, or to upper surface of the inner iron double bottom, if there is one, at middle of length as found in 1.....
4. Greatest length of engine room, including any permanent coal bunkers, between the limiting bulkheads extending from side to side.....

RESULTS OF MEASUREMENT.

Gross tonnage.	Cubic meters.	Deductions.	Cubic meters.
1. Space under tonnage deck		I. On account of space required for propelling power	
2. Space between tonnage deck and the one above		II. Crew, navigation, etc.:	
3. Space between first and second decks above tonnage deck		1. Spaces for sailors, firemen, deck officers, cooks, stewards, etc.	
4. Quarter-deck cabin or poop		2. Spaces for officers, engineers, etc.	
5. Forecastle		3. Wheelhouses, chart house, etc.	
6. Space under bridge deck		4. Sail room	
7. Break or breaks		5. Ship's stores	
8. Other spaces		6. Spaces for water ballast	
9. Excess of hatchways		III. Spaces for the master	
Gross tonnage		Total deductions	

	Cubic meters.	Registered tons.		Cubic meters.	Registered tons.
Gross tonnage			Final result of measurement:		
Deductions			Gross tonnage		
Net tonnage			Net tonnage		

In accordance with the ship measurement ordinance of March 1, 1895, this measurement certificate is made out from the measurement completed on ..... day of ....., 19.., by the measurement board at ..... by the complete method.

.....

.....

NOTE.—The following constructions on or above the upper deck are considered open spaces, and are, therefore, not included in the above measurements of gross and net tonnage:

FOR OPEN VESSELS. FORM B.

GERMAN EMPIRE.

Kind of vessel.	Name of vessel.	Distinctive signal.	Nationality home port.

SHIP'S MEASUREMENT CERTIFICATE.

DESCRIPTION OF VESSEL.

Builder	Number of water-tight transverse bulkheads	Shape of stern
Year built	under covered space	Number of funnels
Place built	Planking	Number of masts
Material		Rigging
Kind of construction	Shape of bow	

STANDARD DIMENSIONS.

Meters.

1. Length of vessel between rear face of prowpost to rear face of sternpost at height of the upper surface of the upper strake.....
2. Width of vessel between outer surfaces of wales at the middle of length as found in 1.....
3. Depth of vessel from point given in section 2, article 20, ship measurement ordinance, to the upper surface of the lower transoms at the middle of length as found in 1.....

RESULTS OF MEASUREMENT.

Gross tonnage.	Cubic meters.	Deductions.	Cubic meters.
1. Space under the uppermost permanent strake (in place of tonnage deck indicated).		I. On account of space required for propelling power	
		II. Crew, navigation, etc.:	
2. Break or breaks (half deck)		1. Space for sailors, firemen, etc	
3. Forecastle		2. Ship's stores, sail room, etc	
4. Other spaces		3. Spaces for water ballast	
		III. Spaces for master	
Gross tonnage		Total deductions	

	Cubic meters.	Registered tons.		Cubic meters.	Registered tons.
Gross tonnage			Final result of measurement:		
Deductions			Gross tonnage		
Net tonnage			Net tonnage		

In accordance with ship measurement ordinance of March 1, 1895, this measurement certificate is made out from the measurement completed this ..... day of ....., 19.., by the measurement board at ..... by the complete method.

.....

FOR STEAM AND SAILING VESSELS MEASURED BY THE ABBREVIATED METHOD. FORM C.

GERMAN EMPIRE.

Kind of vessel.	Name of vessel.	Distinctive signal.	Nationality home port.
.....	.....	.....	.....
.....	.....	.....	.....

PROVISIONAL MEASUREMENT CERTIFICATE.

DESCRIPTION OF VESSEL.

Builder.....	Character of upper deck.....	Planking.....
Year built.....	.....	Shape of bow.....
Place built.....	Number of water-tight transverse bulkheads.	Shape of stern.....
Material.....	.....	Number of funnels.....
Kind of construction.....	Number of water-ballast tanks with hatches.	Number of masts.....
Number of decks.....	.....	Rigging.....

STANDARD DIMENSIONS.

Meters.

1. Length of vessel from the rear face of prow post to rear face of sternpost (in vessels with patent rudder to middle of rudder post) measured along uppermost permanent deck.....
2. Greatest beam of vessel between outer surface of planking or wales.....
3. Perimeter of vessel found according to article 18, ship measurement ordinance, around outer surface of hull..
4. Greatest length of engine room including any permanent coal bunkers between limiting bulkheads extending from side to side.....

MEASUREMENT RESULTS.

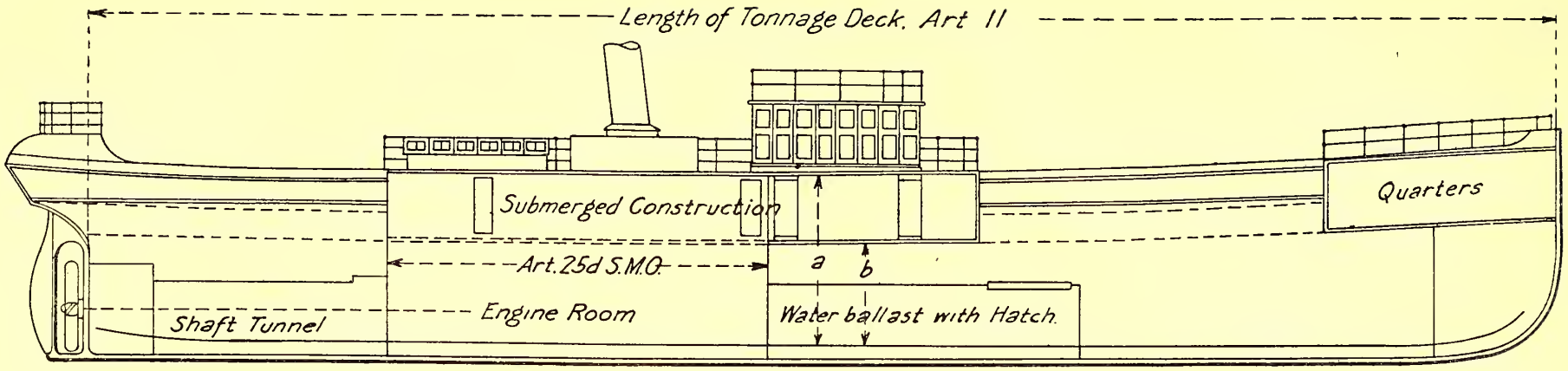
Gross tonnage.	Cubic meters.	Deductions.	Cubic meters.
1. Space under upper deck.....	.....	I. On account of space required for propelling power.....	.....
2. Quarter-deck cabin or poop.....	.....	II. Crew, navigation, etc.:	
3. Forecastle.....	.....	1. Spaces for sailors, firemen, deck officers, cooks, steward, etc.....	.....
4. Spaces under bridge deck.....	.....	2. Spaces for officers, engineers, etc.....	.....
5. Break or breaks.....	.....	3. Wheelhouses, chart houses, etc.....	.....
6. Other spaces.....	.....	4. Sail room.....	.....
7. Excess of hatchways.....	.....	5. Ship's stores.....	.....
		6. Spaces for water ballast.....	.....
		III. Spaces for the master.....	.....
Gross tonnage.....	.....	Total deductions.....	.....

	Cubic meters.	Registered tons.		Cubic meters.	Registered tons.
Gross tonnage.....	.....	.....	Final result of measurement:		
Deductions.....	.....	.....	Gross tonnage.....	.....	.....
Net tonnage.....	.....	.....	Net tonnage.....	.....	.....

In accordance with ship measurement ordinance of March 1, 1895, this measurement certificate is made out from the measurement completed this ..... day of ....., 19...., by the measurement board at ..... by the abbreviated method.

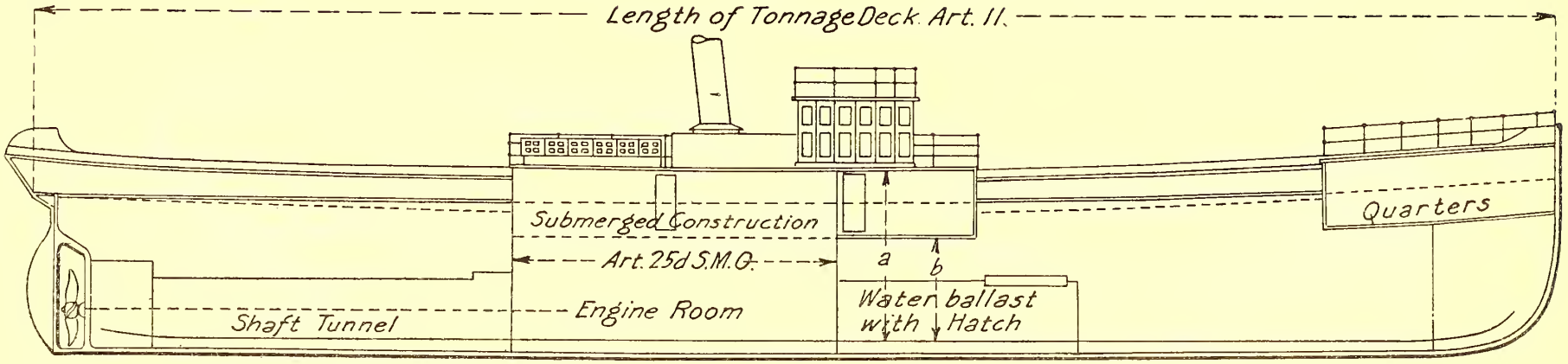
.....

Fig. 1.



a-b = Standard Dimensions Art. 25

Fig. 2.



a-b = Standard Dimensions Art. 25

Fig. 3.

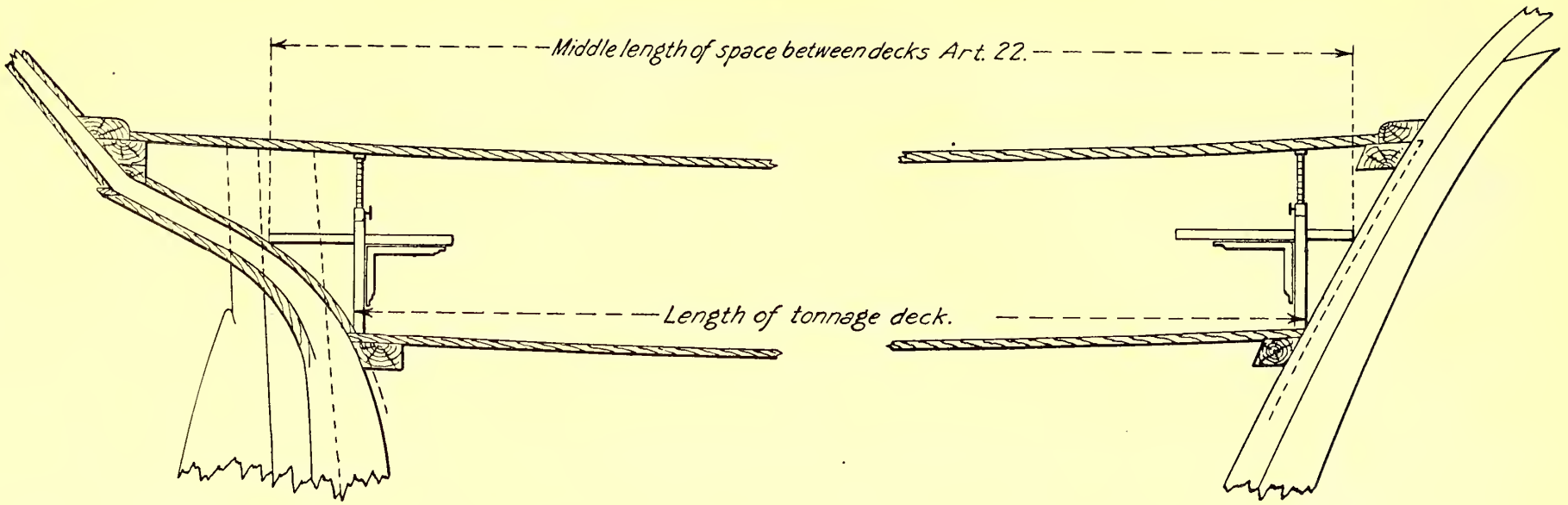

Middle length of space between decks Art. 22.
Length of tonnage deck.

Fig. 4.

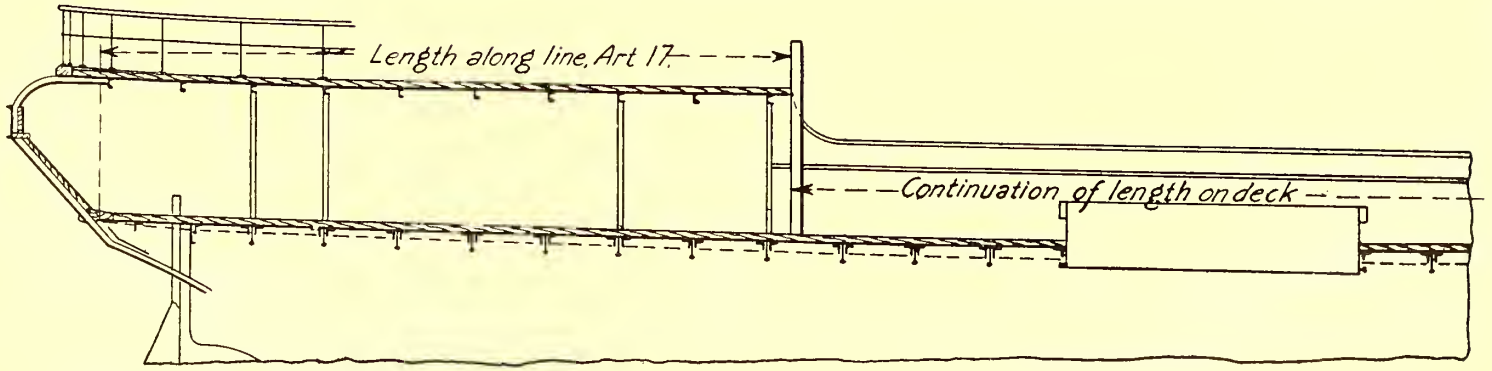

Length along line, Art 17.
Continuation of length on deck

Fig.5.

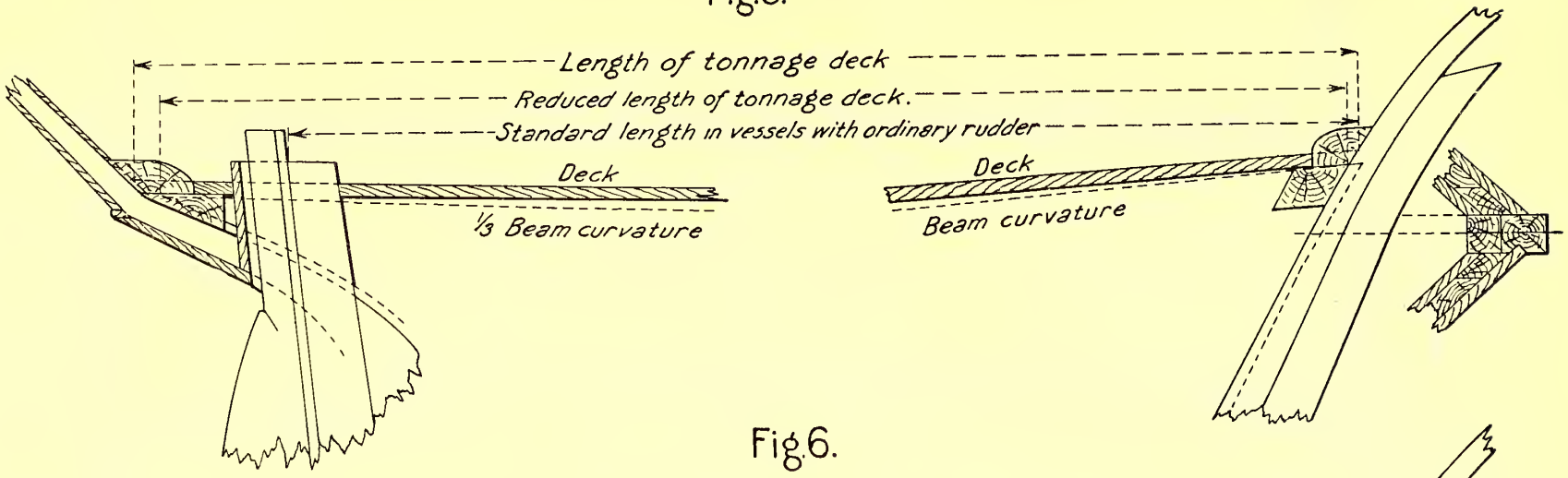
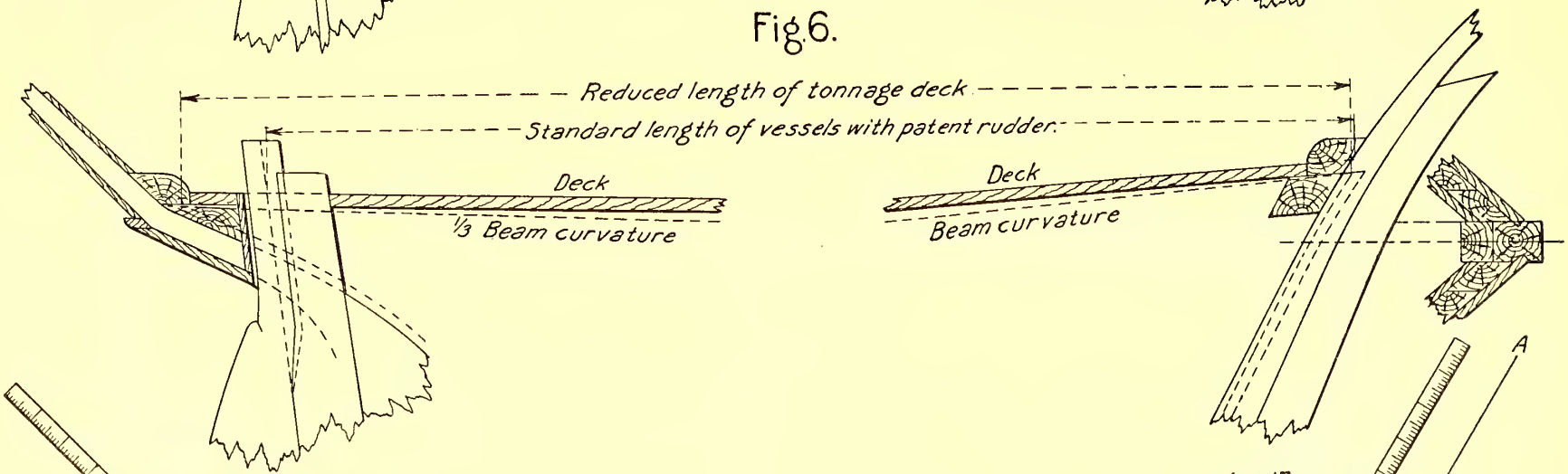


Fig.6.



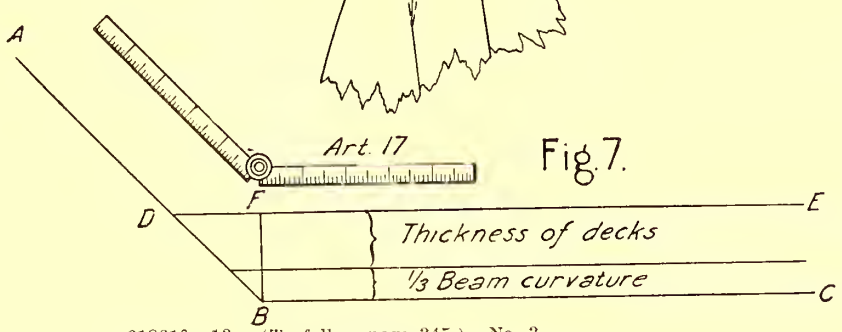


Fig.7.

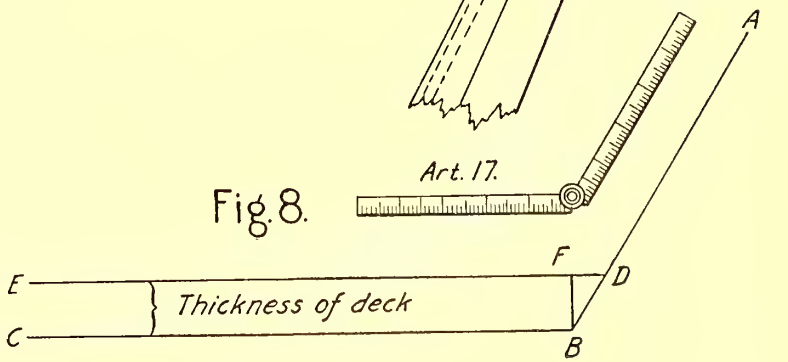


Fig.8.

Fig. 9.

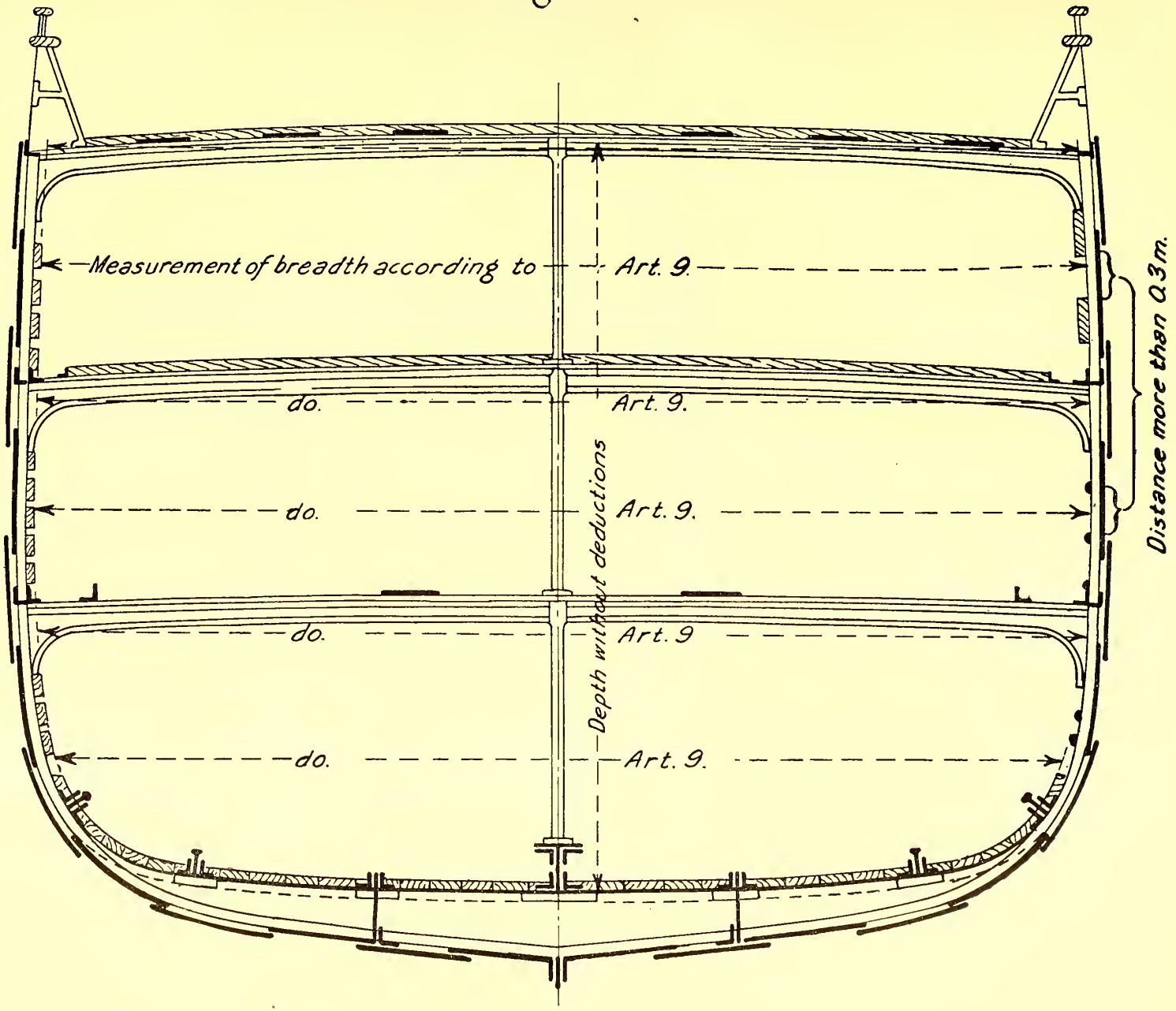

Measurement of breadth according to
Art. 9.
do.
Art. 9.
do.
Art. 9.
do.
Art. 9
do.
Art. 9.
Depth without deductions
Distance more than 0.3m.

Fig. 10.

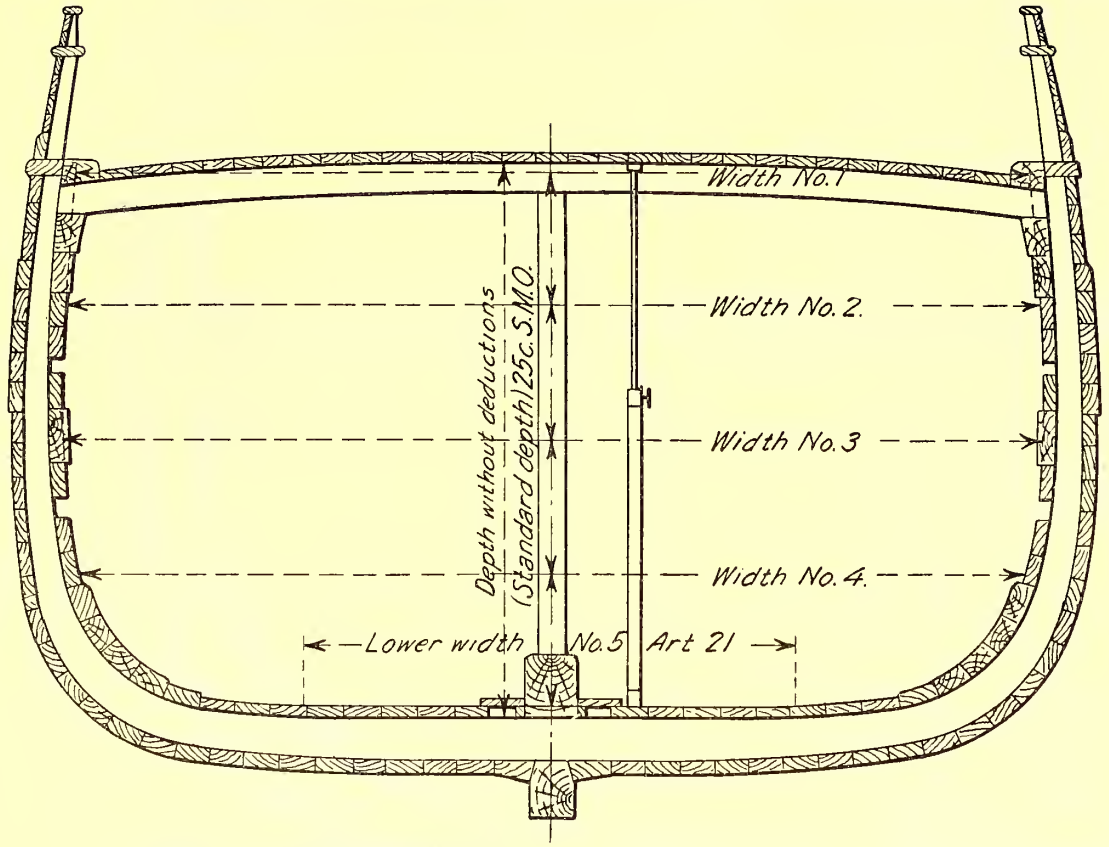

Width No. 1
Width No. 2.
Width No. 3
Width No. 4.
Depth without deductions
(Standard depth) 25c. S.M.O.
Lower width
No. 5
Art. 21

Fig. 11.

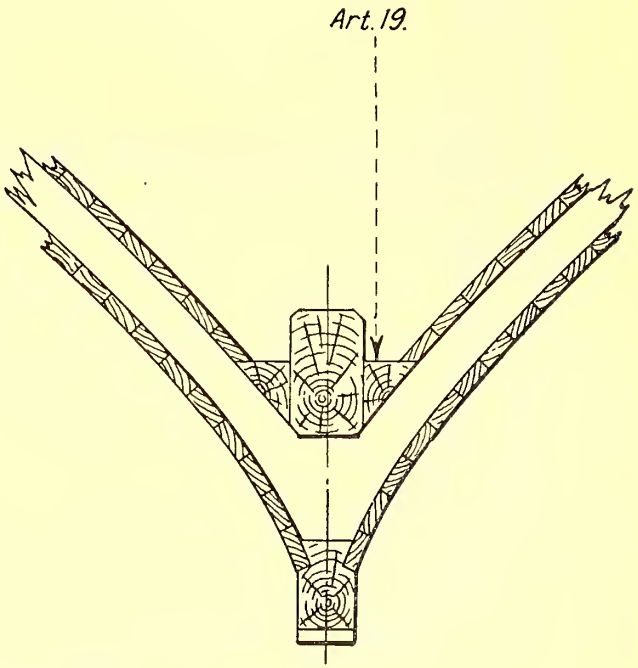

Art. 19.

Fig. 12.

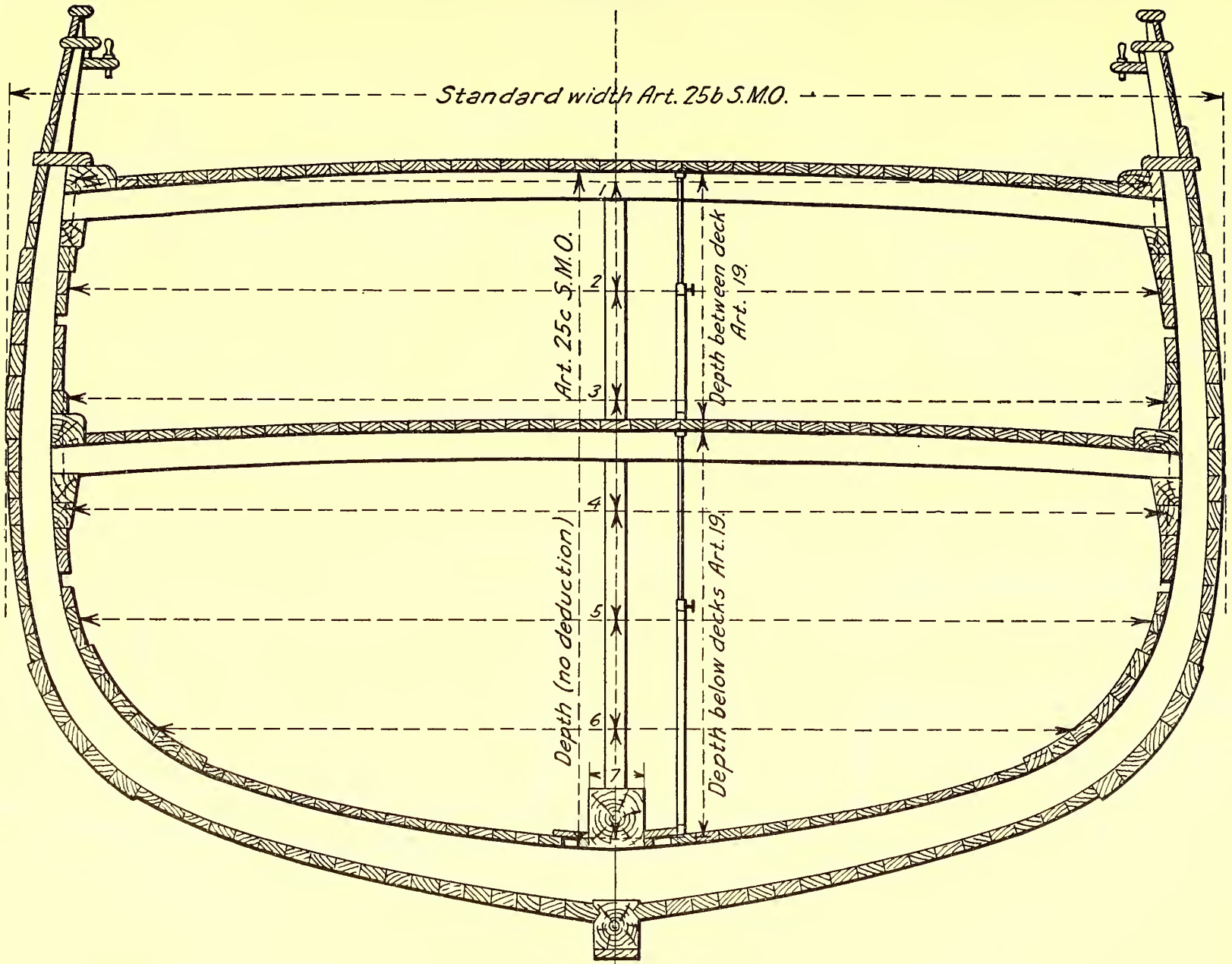

Standard width Art. 25b S.M.O.
Art. 25c S.M.O.
Depth between deck Art. 19.
Depth (no deduction)
Depth below decks Art. 19.
1
2
3
4
5
6
7

Fig. 13.

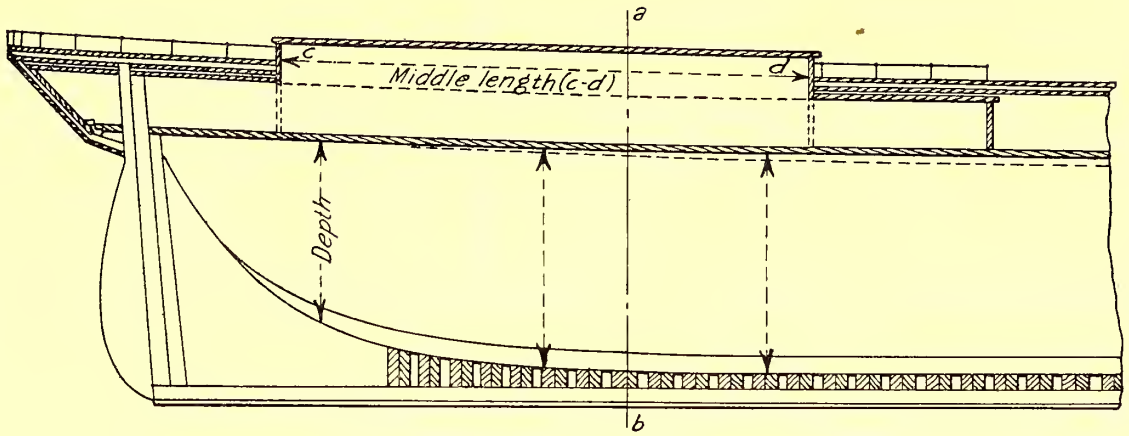


Fig. 14.

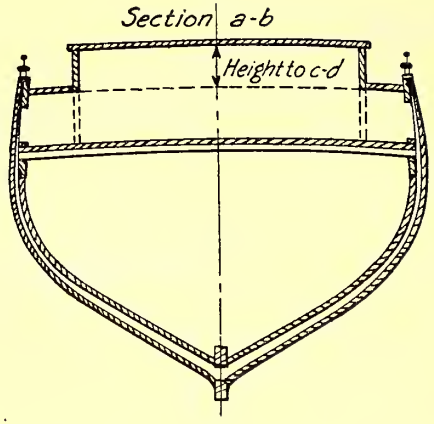


Fig. 15.

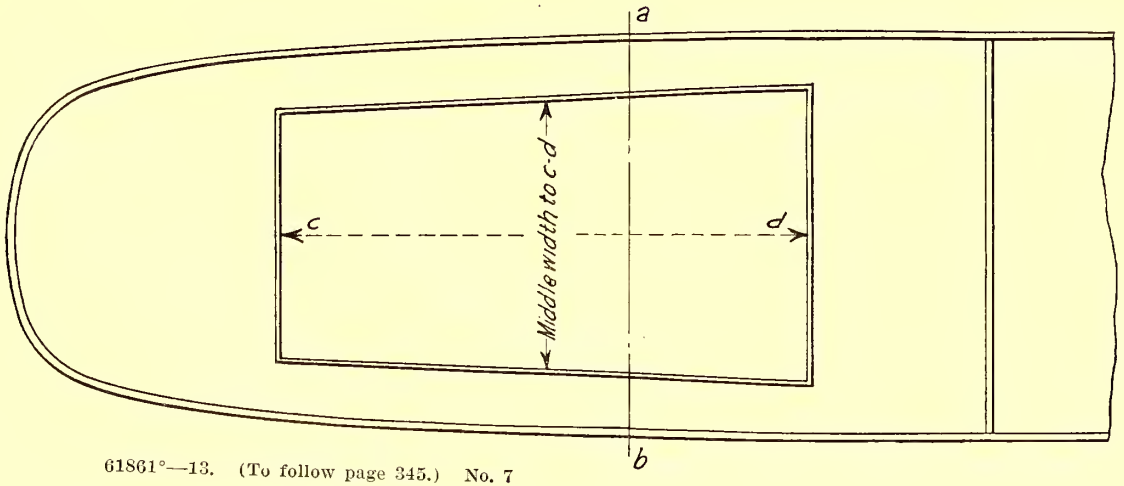
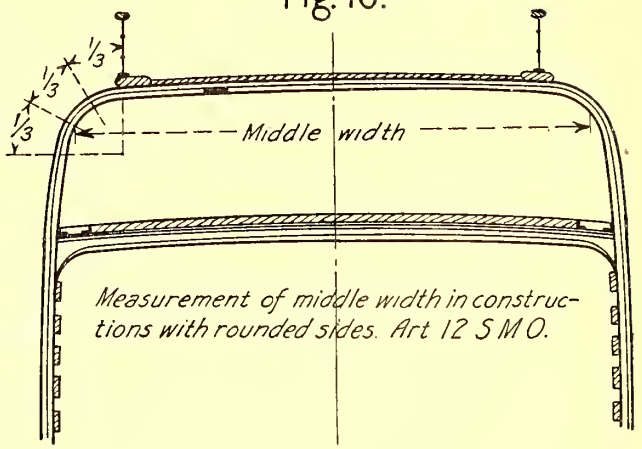


Fig. 16.



Measurement of middle width in constructions with rounded sides. Art 12 S M O.

Fig. 17.

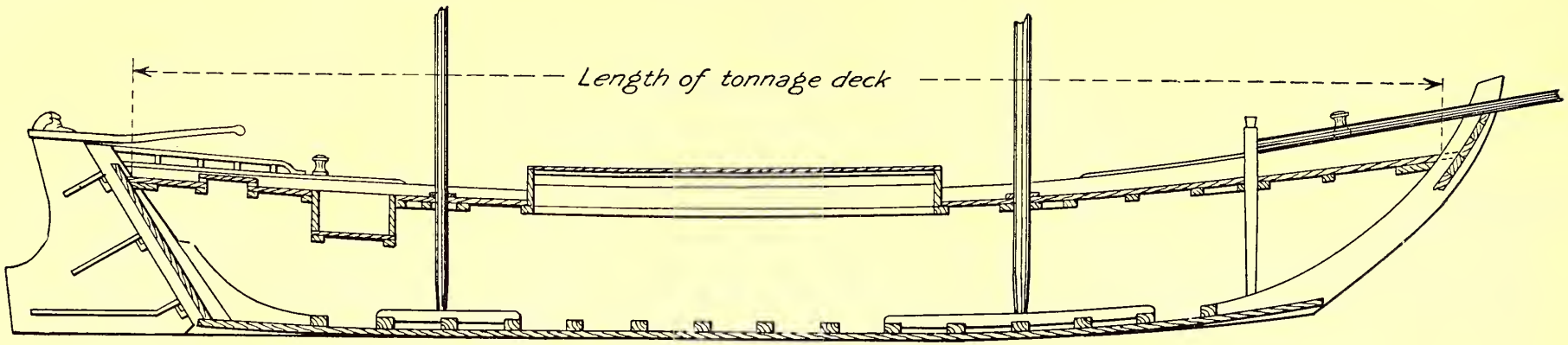


Fig. 18.

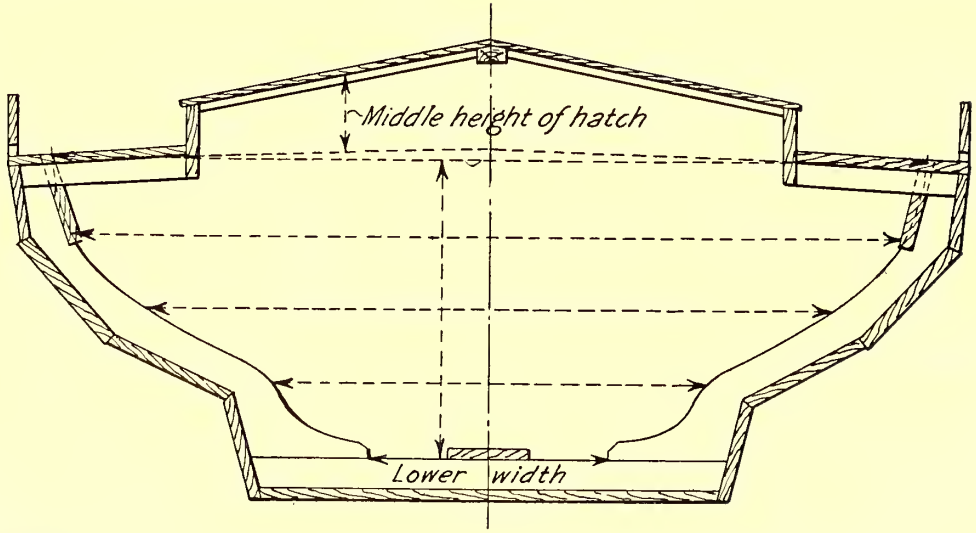


Fig. 19.

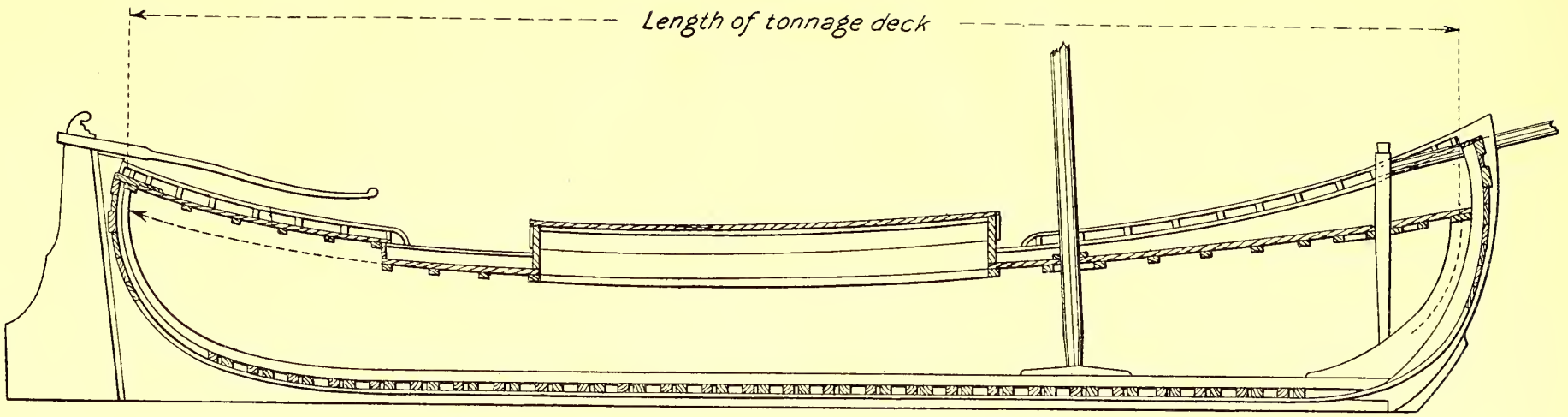


Fig. 20.

Elevation on deck Art. 17.

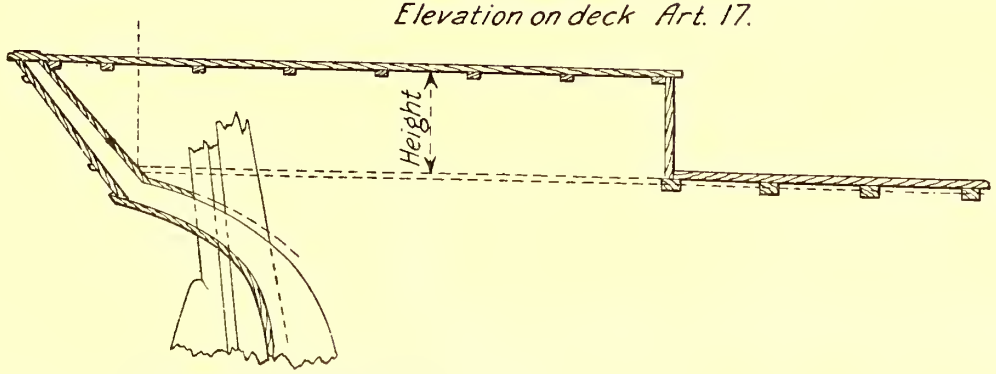


Fig. 21.

Depression in deck Art. 12.

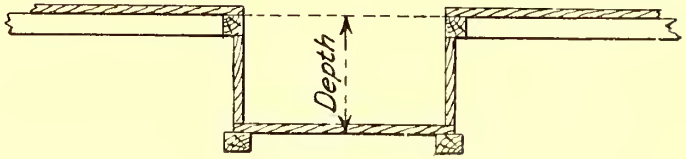


Fig. 22 abolished.

Fig. 23.

Division of Cross Sections according to Art 6 and Art 11 S. M. O.

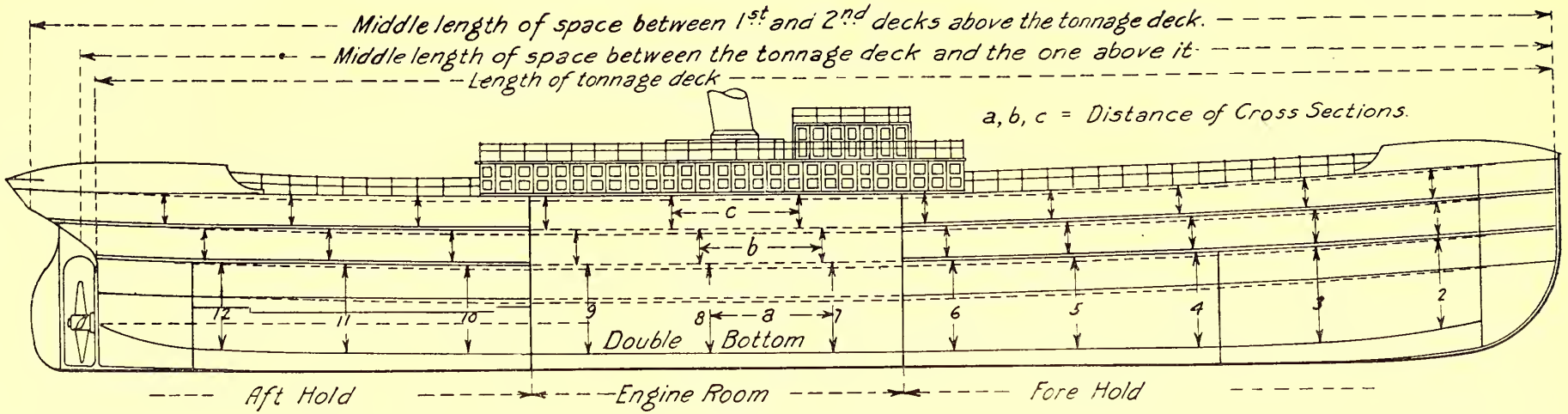
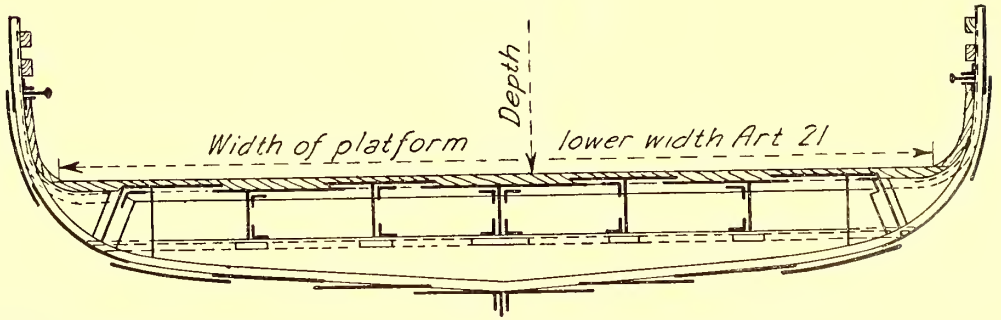


Fig. 24.



APPENDIX VII.

TECHNICAL DIRECTIONS ISSUED DECEMBER, 1908, BY THE GERMAN GOVERNMENT TO THE SHIP MEASUREMENT BOARDS CONCERNING THE EXECUTION OF THE SHIP-MEASUREMENT ORDINANCE OF MARCH 1, 1895.

APPENDIX VII.

TECHNICAL DIRECTIONS ISSUED DECEMBER, 1908, BY THE GERMAN GOVERNMENT TO THE SHIP MEASUREMENT BOARDS CONCERNING THE EXECUTION OF THE SHIP-MEASUREMENT ORDINANCE OF MARCH 1, 1895.

I.—*To articles 4 and 10 of the ship-measurement ordinance.*

SHELTER DECKS.

1. If the upper complete deck of a ship has a permanent opening, i. e., survey opening (figs. 1, 1a, and 2 of drawings hereto attached) of the size and structure as given under I. 2, or, if in the outer sheathing, openings of sufficient size are arranged (compare I. 3, and fig. 2), and if, in addition, in both cases in the sidewall, i. e., below these survey openings, it is provided with ports and scuppers, then, at the written request of the shipowner (compare 1), such a deck is regarded by the measurement boards as a shelter deck or protected deck. As such it is not considered as a tonnage deck (par. 4), nor is the space below to the next deck (par. 10) considered as a between-deck space. The assumption is, however, that in the determination of the freeboard, the vessel is also treated as a shelter-deck vessel, and the freeboard is measured downward from the line of the deck below the shelter deck. This must be proven by a freeboard certificate. (See I. 8.)

The deep-load line of shelter-deck vessels in salt water (including the summer load line for the Indian and Pacific Oceans) must, however, never lie higher than the upper edge of the planking of the deck below the shelter deck, i. e., the upper edge of the plates, if no wooden deck is present. For the deep-load line in fresh water, this consideration of a limit is not prescribed.

SURVEY OPENING IN THE SHELTER DECKS.

2. The size, position, and build of a survey opening in the deck must satisfy the following minimum requirements. (Compare also figs. 1, 1a, 3, and 4.)

(*a*) The deck opening must be arranged symmetrically to the middle plane of the ship.

(*b*) The distance of the aft side of a survey opening, lying in the aft part of the ship, from the after surface of the sternpost must not be less than one-twentieth; and the distance of the fore side of an opening, lying in the forward part of the ship, from the after surface of the stem must not be less than one-fifth of the standard length of the ship.

(*c*) The clear breadth of these openings must at least be equal to the breadth of the aft normal loading hatch on the shelter deck.

(*d*) The clear length of the opening must not amount to less than 1.22 meters (4 feet). (Compare figs. 3 and 4.)

(*e*) In case there is a breast or coaming around the survey opening, it must not be higher than the surface of the iron or the wooden deck by more than 0.3 meters (12 inches).

(*f*) A cover must be only "provisional," not "permanent," wooden covers that can be taken away (not those of iron) are permissible. The covers may also be fastened by means of eyebolts and rope lashings "in the interior of the deck openings." On the other hand, clamps which are riveted or screwed on the coamings, as well as the wooden or iron hatch hangers, are not permissible; the wooden covers, moreover, must not be battened down against one another or against the coaming. Rail supports riveted to the coaming of the survey opening may be constructed only in such manner (compare fig. 3) that the use of them for battening is excluded; because battening itself is forbidden in survey openings.

SURVEY OPENING IN THE OUTER SHEATHING.

3. For the size of the survey openings in the outer sheathing, neither minimum measurements nor building lines are given. Upon request being sent in, they are decided for each case. Beams may pass through these openings.

TREATMENT OF THE SPACES BETWEEN THE SHELTER DECK AND THE UPPER DECK. WATER PORTS, SCUPPERS, AND PASSAGEWAYS SECS. 4 TO 7).

4. If the above given conditions are all fulfilled, or if the side openings in the outer sheathing are regarded as sufficient, then the space, shaded in 1, 1a, and 2, below such survey openings between the bulkheads dividing these fore and aft, can be treated in the survey as if the deck above it were entirely lacking; it can, therefore, be excluded from measurement. The clear measure of the water ports to be made in the shaded spaces is according to the size of the space and the size of the survey opening. There must be, however, on each side a water port of not less than 0.38 by 0.51 meters (15 by 20 inches), the lower edge of which is to lie as low as possible above the deck. For the fixing of the trapdoor which swings toward the outside, a ring bolt with rope gasket is allowed, and a simple cross in the opening in order to prevent objects from falling through is also permissible. For the carrying off of the water in the space shaded (figs. 1, 1a, and 2), there must be on each side at least one scupper leading to the outside, the cross section of which must not be smaller than that of a circular surface of 9 centimeters diameter. Arrangements for the closing of these scuppers must not be present; on the other hand, in case of a larger clear cross section, back valves are permissible. A reliable form of these scuppers is given in fig. 5.

5. The spaces fore and aft of this space, shaded in figs. 1, 1a, and 2, are treated in a technical manner as superstructures. (Secs. 13Aa of the ship-measurement ordinance.)

6. If such superstructures, by means of transit openings in the bulkheads, are made into open ones, the construction directions given in II. 1, with the exception of iron plates, are to be followed. In case these superstructures are used for cargo, travelers, or troops, that which is contained in Rule II. 4 holds good.

In these superstructures under the shelter deck, every division made by cross bulkheads must have on each side of the ship at least one scupper of the construction and size as stated under 4. In case of large divisions, several scuppers will be necessary in each division.

7. Differentiating from the instructions under II. 1, only one transit opening is necessary if the survey opening is arranged in the boundary position in the bulkhead lying in the front or back of it, i. e., of the poop or rear bulkhead. This opening, however, must lie amidships in order to make this superstructure, which is shut off by a bulkhead, into an open structure which can likewise be shut off. (Compare the aft bulkhead in the shelter deck in fig. 1a.)

8. With every written request of an owner which has been filed with the measurement boards for the exclusion of the shelter deck and the superstructures under the shelter deck, there must be two copies of the plans of the ship. The length sections and deck plans, on which the position of the survey openings, the water ports or scuppers, and of the presumptive situation of the deep-load line are shown, must be inclosed. There must also be shown in the drawing, by shading, what parts of the superstructure under the shelter deck are to be excluded from measurement. Detailed drawings (2 copies) are to be handed in containing a written statement of the dimensions of the survey openings in the shelter deck, of the sides of the ship, of the transit openings in the end and bulkheads, of the superstructures which are to be excluded, and of the portholes and the scuppers. These drawings must show plainly the type of the intended provisional opening. Every change of the opening is to be indicated to the measurement boards, according to section 33 of the ship-measurement ordinance.

Without a written request, the treatment of a ship as a shelter-deck ship, or the exclusion of the superstructures lying under the shelter deck, may not take place, even when the conditions made are fulfilled. The ship-measurement boards must immediately lay before the bureau of registry the request of the shipowner with a copy of these drawings.

In case of old ships, which have already received a freeboard mark, the proof demanded under I. 1 must be given by handing in the freeboard certificate, or a copy of it, upon making

the request. In case of new ships, however, it is only necessary that a declaration be made in the request by the owners that the conditions regarding the freeboard will be fulfilled. The further control of it is exercised directly by the Bureau of Registry. During the measuring, or in case of new ships during final measurement, the agreement of the construction of a ship with these drawings is to be determined and to be certified on the drawings by the measurement boards.

II.—*To article 13Aa.*

SUPERSTRUCTURES WHICH ARE BUILT OPEN BY MEANS OF OPENINGS IN THE END AND BETWEEN BULKHEADS.

1. Superstructures (poop, bridge house, and forecastle) are to be looked upon as not closed and as not suitable for the stowing of goods or provisions, or for the housing or other conveniences of the ship's crew and passengers, and, therefore, according to article 13Aa of the ship-measurement ordinance, to be excluded from measurement, if in one of the end bulkheads upon each side of the ship there is at least one opening. For the size and arrangement of such openings, the following conditions control. (Compare also figs. 6 to 13.)

(*a*) The clear width must at least amount to 0.91 meters (3 feet).

(*b*) The clear height to be at least 1.22 meters (4 feet).

(*c*) The foot plate (sill), if there be one to the opening, must not be more than 0.61 meters (2 feet) above deck.

(*d*) The opening may be provisionally closed. There must, however, be no doors or other means which are applied permanently, as, for instance, bolt holes, door hinges, etc., which indicate the intended permanent closing of the openings in the bulkhead. The opening is looked upon as provisional if planked pieces are loosely laid between(⊏ or ⌐) iron channel or angle bars (figs. 6 to 8), or wooden frames or iron plates are used (figs. 9 to 13). Such frames and plates may be held down either by means of hook bolts which encircle angle irons fastened to the bulkheads within the opening, or by wooden or iron crosspieces which are laid loosely diagonally across the opening (figs. 12 and 13).

In case of none of these provisional openings, however, may battening material be used.

If one part of the superstructure is bordered by a bulkhead (see fig. 1a) reaching from side to side, then this space is also exempted, provided there are openings in this bulkhead on each side of the ship, the size and build of which correspond to the above stated conditions. It does not matter whether the bulkhead is of iron, steel, or wood, or whether the latter consists of fastened or only loose planks not screwed. Only lath bulkheads are left out of consideration.

If in the end bulkhead, or between the bulkhead of a superstructure which reaches from side to side, there is only one opening on the side of the ship of the already stated size and build, then the superstructure is to be excluded from the measurement only if, besides that, a sufficient number of ports and scuppers are arranged on each side of the ship for letting off the water. Ports and scuppers must meet the conditions given under I. 4. If the space is divided by between bulkheads, there must be, besides the scuppers, at least one port in every division on each side of the ship.

SUPERSTRUCTURES BUILT OPEN BY MEANS OF OPENINGS IN THE SIDES.

2. Superstructures (poop, bridge house, and forecastle) are to be looked upon as not closed if their sides have openings which are sufficiently long and high. In this case ports and scuppers are necessary. The regulations under I. 4 and 6 hold good here also, with the difference that iron plates are admissible as provisional covers for the openings in the bulkheads.

COVERED WELL.

These regulations also apply to ships in which the side openings have arisen not by being cut through the outer sheathing, but simply by the poop, the forecastle and the bridge house being connected above by means of a deck with a sheerway, and below by a canvas bulwark, a covered "well" being in a certain sense thus created.

SUPERSTRUCTURES BUILT OPEN BY MEANS OF OPENINGS IN THE DECK.

3. Superstructures can, finally, just as spaces under the shelter deck, become "not closed ones," in the sense of article 13Aa of the ship-measurement ordinance, by means of openings in the deck in connection with ports and scuppers.

Concerning the deck opening (opening for survey), the conditions given under I. 2a and c to f must be fulfilled.

At least one port must be arranged on each side of the deck opening. In addition to that, the space as well as any of its divisions, in case it is divided by between bulkheads, must allow the water to run off through the scuppers. For the choice in the measurement of the ports, the number of scuppers, and the arrangement and sizes of both, the directions given under I. 4 hold good.

USE TO WHICH OPEN SUPERSTRUCTURES ARE PUT.

4. Whatever cargo is carried in these spaces excluded from measurement, according to 1 to 3, does not affect the measurement. If, however, in any of the excluded superstructures or any parts of them, passengers or troops are actually housed, or if such superstructures serve only as conveniences for passengers or troops, then the superstructures in question must be included in the measurement, whether a change of the arrangement for the closing has taken place or not.

APPLICATION FOR EXEMPTION. FREEBOARD.

5. Upon the written request, without which the exclusion of the superstructures reaching from side to side can not take place, the directions under I. 8 are applicable. (Compare also fig. 1.)

The proof demanded in the case of shelter-deck ships concerning the freeboard is not necessary in the case of superstructures.

III.—*Article 13Bc.*

BAKERIES.

In addition to that which is stated in article 13Bc, bakeries in which there are baking ovens are also excluded from measurement.

IV.—*Article 14 under 5.*

WATER BALLAST TANKS.

In contrast to double bottoms, all other water ballast spaces that are built solidly into the ship, as for instance the collision compartments, high tanks, side and topside tanks, deck tanks, etc., are measured into the gross tonnage and again deducted. It does not matter whether they extend from side to side or not, or where they lie: (1) If they are meant for the reception of water ballast; (2) if they are accessible only by manholes of ordinary size; and (3) if they are designated plainly as water ballast spaces.

The shipowner is, however, first to make a written request for the deduction to the ship measurement boards, and plainly to designate these tanks with the manholes in the ship's drawings, according to article 31 of the ship measurement ordinance. Only in doubtful cases are special drawings of these tanks and explanation about their use to be submitted by the shipowner. The form and number of the manholes is a matter of indifference.

The deck of such a tank must be water-tight and solidly built; cement fillings between the beams are not regarded as water-tight construction.

In case of older ships, in which deduction of such tanks has not yet been made, a request by the shipowner for such deduction can be granted. Each part of the side tanks that lies between water-tight tank bulkheads is measured by itself and marked as water ballast space.

In the calculation of the contents of every part, its height is to be divided into as many parts of a whole number as is prescribed for the depths in the cross section of the ship below

the tonnage deck. The breadth of these water ballast spaces is measured clear from the inner plank to those places which are the standard for the measuring of the breadth in the determination of the contents of the cross section below the tonnage deck.

TOPSIDE TANKS.

In the same manner each separate topside tank is measured by itself.

COLLISION COMPARTMENTS.

In calculating the contents of collision compartments, the same height of the floor timbers is everywhere taken, i. e., the one taken at the collision bulkhead; or if the height of the floor timbers lying alongside in the collision compartments is less, then the latter is taken (compare 14 and 15). The contents of the collision holds are always determined by means of vertical cross sections. In case of collision holds of ordinary length, three cross sections will be sufficient.

If a collision hold reaches above the upper deck, up to a half deck, then the part under the upper deck is to be computed in the above way. The part lying above it is to be reckoned as a superstructure, i. e., its horizontal cross section to the half height is to be measured at three breadths, and the surface of this cross section is to be multiplied by the mean height.

If the screw shaft without bulkheads leads through the water ballast space, the tank is deducted from the gross tonnage; but a real shaft tunnel within the tank is not added to the actual engine room.

V.—*Article 15 under 3.*

SHAFT TUNNELS AND SPACES FOR THE THRUST BEARING WITHOUT BULKHEADS.

In case of vessels with a shaft tunnel and thrust-bearing space without bulkheads the following is to be observed for ascertaining their contents:

(*a*) FOR SINGLE SCREW SHIPS.

For the shaft tunnel, the usual measurements corresponding to the size of the ship are to be chosen. For the thrust-bearing space, the breadth can be determined in such manner that the bearings are accessible on all sides, and the nuts on the same can be tightened. For the height of this space, such a dimension is to be used as is necessary to carry on all work within it. In general, in small ships, a height of 2.14 meters (7 feet) is sufficient.

(*b*) FOR TWIN SCREW SHIPS.

If the shaft tunnels or the bearings lie free in a space extending from side to side (it is not a question here of separation from the real engine room), the whole breadth of the space from board to board can be taken into consideration in determining the actual engine-room space. If, however, there are dynamos, ice, and other such auxiliary machines which are not directly a part of the main engine, their holds are first separated from the shaft and bearing space, inclusive of the space necessary for attending to them (perhaps 0.3 meter in circumference); and this is also done with the height of the auxiliary machine in so far as it does not extend beyond the height of the shaft and bearing space which is to be taken into account. In case of small steamers, a height of the bearing space of 1.83 meters (6 feet) is generally sufficient. Magazines are also deducted from the shaft and bearing spaces.

VI.—*Article 15 under 4.*

CALCULATION OF THE LENGTH OF THE LIGHT AND AIR SHAFTS FOR THE ENGINE AND BOILER ROOMS.

The length of light and air shafts which are to be taken into account must not exceed the length of the engine and boiler rooms. If a part of the deck plated-over reaches into the shaft the length of this part is deducted from the length of the shaft which is in this deck.

For these shafts, no greater width, independent of the real breadth, must be taken into account than one-half of the largest interior breadth of the ship in the middle.

This limitation, however, ceases if, in the case of small ships, the boiler requires a wider space.

VII.—*Article 16 of the instructions for ship measurement, paragraph 3 under 3.*

LENGTH OF THE ACTUAL ENGINE ROOM.

The aft limitation of the actual engine room, i. e., of the hold which is exclusively occupied by the engine and boilers and is necessary for the effective handling and proper working of the same, shall not be any farther back of the end surface of the cylinder or the slide valve than is necessary. In general, 1.22 meters (4 feet) is considered sufficient space. Greater measurement can not be taken into account without directions of the Bureau of Registry.

If certain conditions make a diversion from the directions concerning the measurement of the actual engine-room space necessary, according to the view of the measurement boards, the affair is to be laid before the Bureau of Registry with explanation and drawings for decision before a survey can be made.

VIII.—*In ascertaining the actual engine space, the aforementioned limitations:*

Shall not be applied in the case of fishing steamers, tugboats, or yachts, nor in case of screw or paddle wheel steamers the deduction of which for the spaces of the propelling power amount to 32 per cent of the gross tonnage for screw and 37 per cent for side wheel steamers.

1. In regard to the height of the bearing space. (Compare V.)
2. In regard to the length of the engine, boiler, light, and air shafts. (Compare VI, sec. 1.)
3. In regard to the length of the engine room. (Compare VII.)
4. In regard to the length of the boiler space. (Compare art. 16 under 3, pars. 3 and 4, of the instructions for ship measurement, Mar. 26, 1895.)

The directions under VI, section 2, however, in regard to the breadth of the engine and boiler shafts, and that under V. b, concerning the auxiliary machines and magazine spaces, apply to such vessels.

The former technical rules of February 7, 1907, are hereby annulled.

IMPERIAL BUREAU OF REGISTRY.

BERLIN, *December, 1908.*

APPENDIX I.

I. *Form of request for the treatment of a ship as a shelter deck ship, and for the exemption of spaces under the shelter deck.*

On the basis of the inclosed drawings, I make request that my steamer ——— be regarded in the survey as a shelter-deck ship, and that the spaces which are shaded in the length section and deck plans be exempted from measurement.

FOR SHIPS WITH FREEBOARD CERTIFICATE.

The freeboard is set off from the deck under the shelter deck (see the inclosed copy of the freeboard certificate), and the deep-load line in salt water (including the summer-load line for the Indian and Pacific Oceans) does not lie above the deck line under the shelter deck.

WITH SHIPS WITHOUT THE FREEBOARD CERTIFICATE.

The treatment of the ship as a shelter deck ship will be requested. In any case, I bind myself to guarantee that the deep-load line, including that for the Indian and Pacific Oceans, does not come above the deck lying below the shelter deck. If passengers are carried in all or in parts of the exempted space, I bind myself to have the ship surveyed for the purpose of having these spaces measured, regardless of whether a structural change in the openings has taken place or not.

II. *Form of request for the exemption of superstructures which are built open.*

On the basis of the inclosed drawings, I ask for the exemption of the shaded parts of the ——— of the length section and deck plan of my steamer ———. In case passengers are carried in all or in parts of the exempted spaces, I guarantee to have the ship surveyed for the measurement of these spaces, regardless of whether a structural change in the openings has taken place or not.

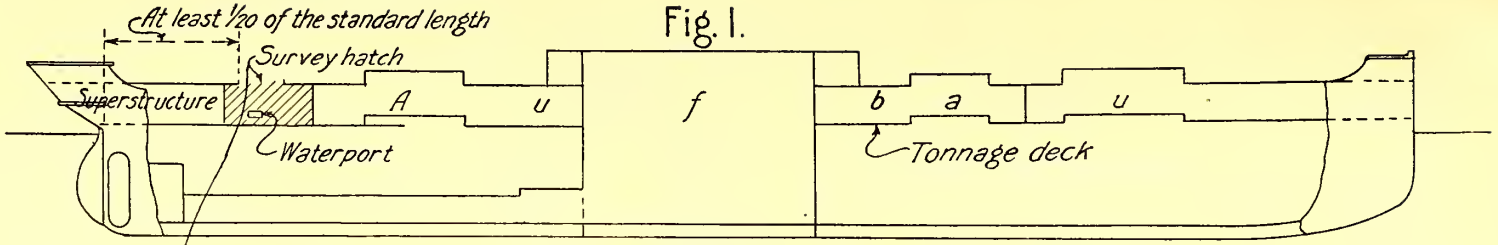


Fig. 1.

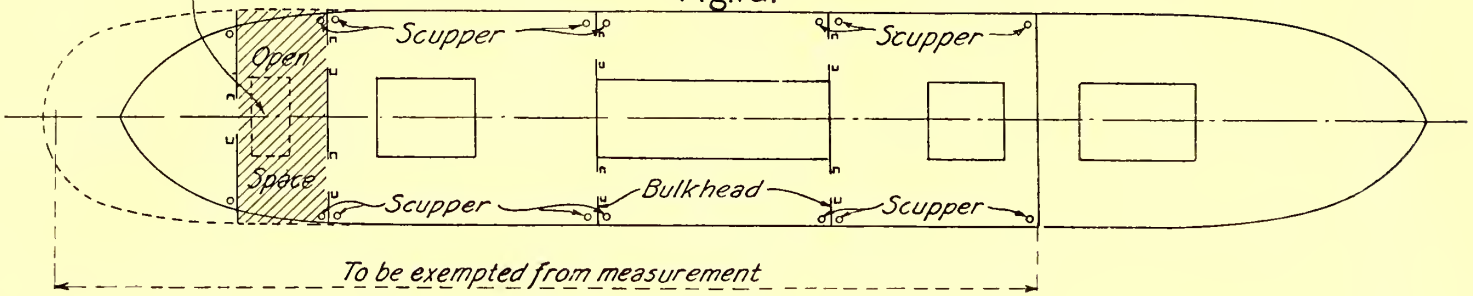


Fig. 1a.

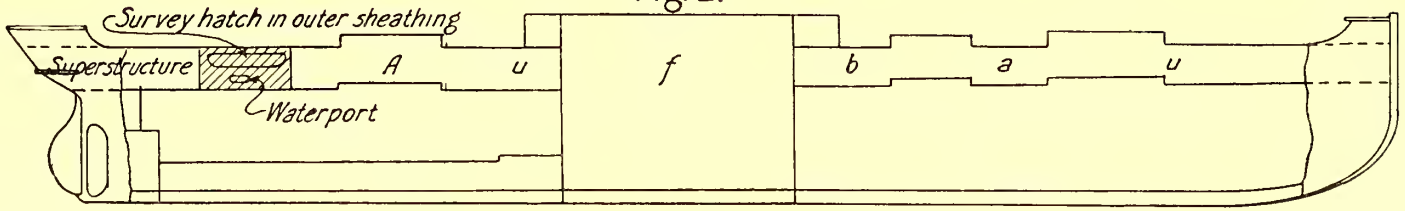


Fig. 2.

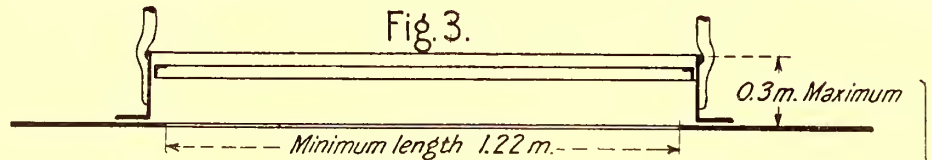


Fig. 3.

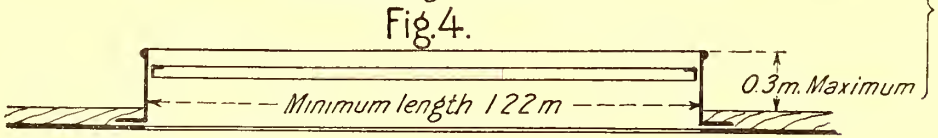


Fig. 4.

Minimum width = to the aft loading hatch

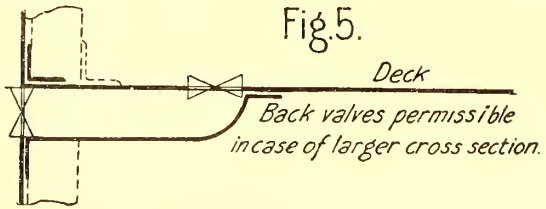


Fig. 5.

Fig.6.

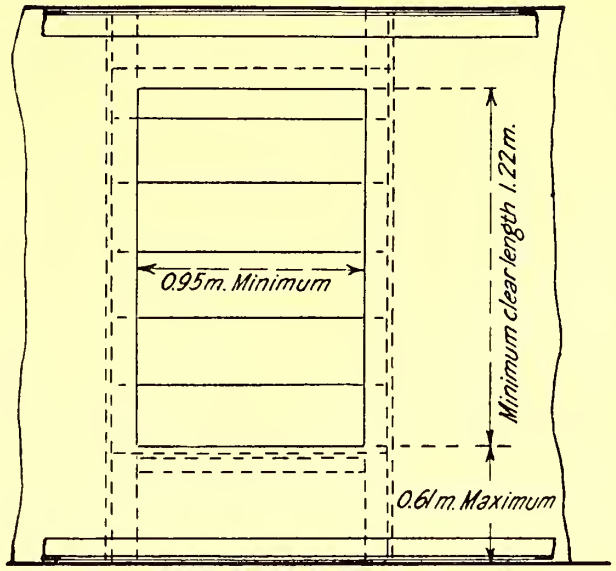


Fig.8.

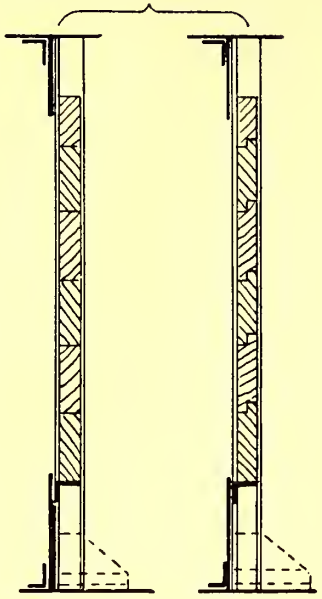


Fig.9.

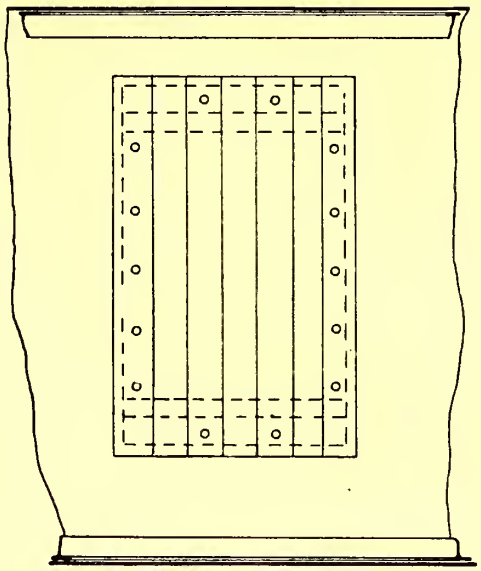


Fig.10.

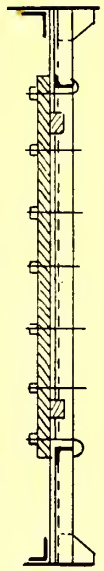


Fig.12.

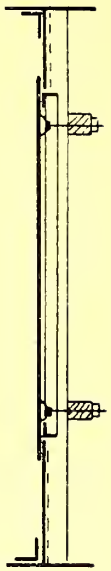


Fig.7.

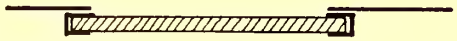


Fig.11.

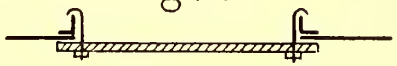


Fig.13.

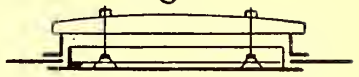


Fig.14.

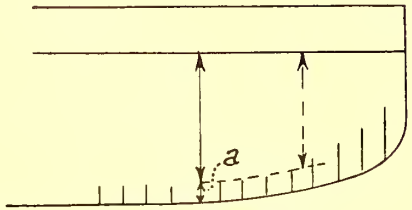
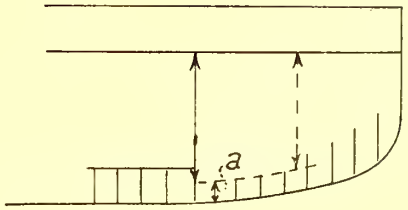


Fig.15.



APPENDIX VIII.

COMPARATIVE ANALYSIS OF THE FRENCH, BRITISH, AND GERMAN SHIP MEASUREMENT RULES.

APPENDIX VIII.

COMPARATIVE ANALYSIS OF THE FRENCH, BRITISH, AND GERMAN SHIP MEASUREMENT RULES.[1]

A.—*Methods of measurement.*

The Tonnage Deck.

FRANCE. | **ENGLAND.** | **GERMANY.**

The tonnage deck is the second deck from the bottom. The only difficulty that arises comes from the omission of the first or lower deck, which is sometimes replaced simply by beams, and is sometimes entirely omitted, as, for example, in web-frame ships. In such cases the tonnage deck is the first or lower deck.

THE MEASUREMENT AND DIVISION OF THE LENGTH.[2]

The length of deck is determined in the same way in all three countries.

In the case of ships with regular bottom lines the deck is divided up into sublengths in the three countries in accordance with the following tables:

Ships 15 m. or less in length, 4 divisions.	Ships 50 feet or less in length, 4 divisions.	Ships 15 m. or less in length, 4 divisions.[2]
Ships 15 m. to 37 m. in length, 6 divisions.	Ships 50 feet to 120 feet in length, 6 divisions.	Ships 15 m. to 35 m. in length, 6 divisions.
Ships 37 m. to 55 m. in length, 8 divisions.	Ships 120 feet to 180 feet in length, 8 divisions.	Ships 35 m. to 55 m. in length, 8 divisions.
Ships 55 m. to 69 m. in length, 10 divisions.	Ships 180 feet to 225 feet in length, 10 divisions.	Ships 55 m. to 75 m. in length, 10 divisions.
Ships 69 m. to 85 m. in length, 12 divisions.	Ships more than 225 feet in length, 12 divisions.	Ships 75 m. to 95 m. in length, 12 divisions.
Ships 85 m. to 103 m. in length, 14 divisions.		Ships 95 m. to 115 m. in length, 14 divisions.
Ships 103 m. to 122 m. in length, 16 divisions.		Ships more than 115 m. in length, 16 divisions.
Ships 122 m. to 144 m. in length, 18 divisions.		
Ships more than 144 m. in length, 20 divisions.		

When a ship has an irregular bottom line, the ship is first divided up into several longitudinal sections by erecting vertical planes at the points where there are abrupt changes in the bottom line. The length of the various sections of the

[1] Translated by Capt. J. H. Slattery, C. E., and Lieut. C. Garlington, C. E., from "Etude Sur le Jaugeage," by V. Beret, *Controleur-Adjoint de la Navigation de la Compagnie Universelle du Canal Maritime de Suez*, 1905. Additions and changes have been made in English and German rules to bring them up to date.

[2] The measurement and division of the length. The present division in Germany (ship measurement ordinance, art. 6):

Ships of 15 meters or less in length	4 divisions.
Ships of 15 meters to 37 meters in length	6 divisions.
Ships of 37 meters to 55 meters in length	8 divisions.
Ships of 55 meters to 69 meters in length	12 divisions.

FRANCE.

When a ship has an irregular bottom line, the division into lengths is made in the same way.

ENGLAND. | **GERMANY.**

deck are then determined in accordance with the above tables, just as if each section were the deck of a separate ship.

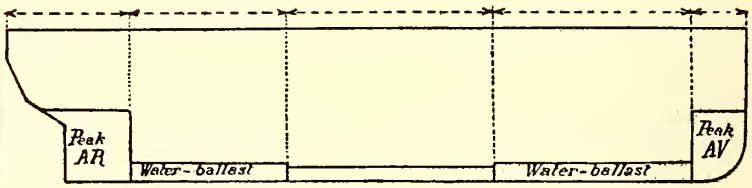


Fig. 1.

When the length of a section is equal to or less than 30 feet, it is divided into only two parts.

In the case of very short sections the measurement is frequently performed by means of horizontal planes.

Sometimes also very short sections at the ends are avoided by neglecting the breaks at the peaks fore and aft. Afterwards the peak spaces thus included in the measurement are deducted from the principal volume.

MEASUREMENT OF THE DEPTH.

In ships of regular bottom lines the depth is measured in the same way in all three countries, to wit: From a point at a distance below the deck equal to one-third of the rise of the deck above the right line joining its edges, to the top of the frames, or to the inner sheathing of the double bottom when there is one.

In every case where there is an inner sheathing or ceiling, the average thickness of this sheathing is deducted.

When the inner sheathing is built upon scantlings the thickness of these scantlings is also deducted.

When the inner bottom sheathing is built on scantlings the thickness of these scantlings is not deducted in either England or Germany.

When there is a double bottom with a roof-like inner sheathing, as indicated in fig. 2, there is added to the depth a correction A, B, equal to one-half of A, C.

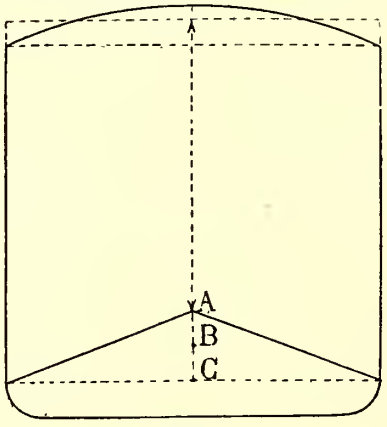


Fig. 2.

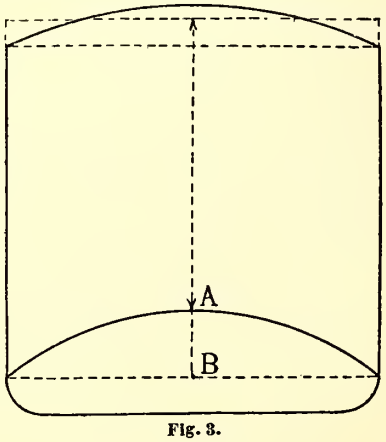


Fig. 3.

FRANCE.

Where the bottom line is irregular, they substitute for it, in France, an imaginary bottom line formed by prolonging the highest line of the double bottom until it intersects the line of the frames at the extremities of the ship.

Fig. 4.

The depths are taken to the bottom line thus formed.

The depth is divided up in accordance with the following table:

Depth of 5 m. or less, 4 parts.

Depth of more than 5 m., 6 parts.

ENGLAND.

When the inner sheathing of the double bottom is curved, as in fig. 3, the correction added is sometimes equal to one-half of the rise A, B, and sometimes one-third of this distance. The practice is not uniform on this point. The practice of adding a third, as is done to allow for the curvature of the deck, seems the most correct.

When the bottom line is irregular, the depths are measured in every one of the several sections of the ship formed by erecting vertical planes through the points where there are abrupt changes in lines—just as in ships with regular bottom lines.

DIVISION OF DEPTH.

Where there is no double bottom or where the double bottom is such that the lowest width measured would be zero, or a very small figure, the depth is divided up in accordance with the following table:

Depth of 16 feet or less, 4 parts.

Depth of more than 16 feet, 6 parts.

GERMANY.

Depth of 5 m. or less, 4 parts.

Depth greater than 5 m., 6 parts.

Where there is a double bottom such that the lowest width would be zero, or very small, the depth is divided into a number of parts greater by one than those given above (making 5 or 7 parts, according to circumstances), and the lowest part is again subdivided into 4 more parts. (Fig. 5.)

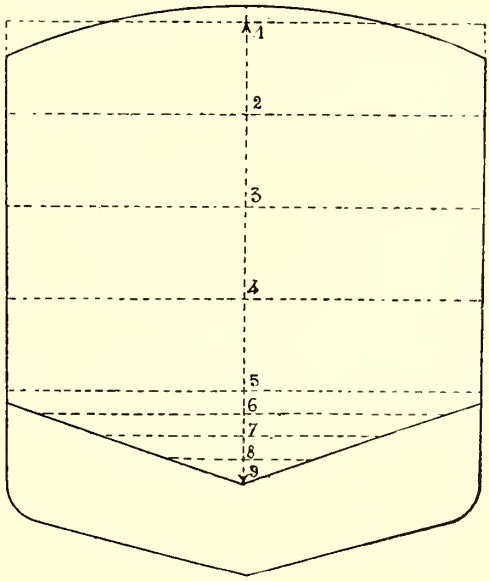


Fig. 5.

FRANCE.	ENGLAND.	GERMANY.

MEASUREMENT OF THE WIDTH.

The depth having been subdivided into several parts, as explained, the width of the ship between the inside faces of the ribs is measured at the several points of division.

If there is an inner sheathing, the widths are measured between the inner faces of this sheathing reduced to its mean thickness.

In the case of refrigerator compartments, the width is taken between the inner faces of the sheathing in direct contact with the ribs.	In the case of refrigerator compartments, a thickness of 3 inches on each side of the ship is allowed for the thickness of the sheathing. Any excess of thickness of the sides over this amount is included in the measurement of the width.	In the case of refrigerator compartments, the widths are, at the present time, taken between the inner faces of ribs without any deductions. It is probable that the Germans will soon conform to the English practice on this point.

When there are water-ballast spaces in the sides, the inner sheathing of which rests directly on the ribs, the widths are taken between the inner faces of the inner sheathing.

France they have not yet treated the case of an interior sheathing of a water-ballast space not resting immediately upon the ribs. They seem inclined in such case to measure the width only to the face of the inner sheathing, subject to the condition that the water-ballast space can not be used for the transportation of merchandise, provisions, or fuel.	If the inner sheathing of a water-ballast tank does not rest directly upon the ribs, the widths are taken between the inner faces of the inner sheathing, subject to the condition that the water-ballast space may not be used for merchandise, provisions, or fuel.[1]	If the inner sheathing of a water-ballast tank does not rest directly upon the ribs, the widths are taken between the interior faces of the inner sheathing, if the water-ballast space can not be used, and is not separated from the water ballast in the double bottom. But if it forms a water-ballast space separated from the double bottom, the widths are taken to the inner faces of the ribs. It is probable that the German practice will eventually follow the English practice.[2]
	The measurement of the first or upper width presents some peculiarities in certain special English ships.	
This case never arises in France. The English practice would probably be followed.	In the case of a turret ship (fig. 6), the sides are assumed to continue up to the top of the turret, M, M′, M″, M‴, and the tonnage deck becomes A B between these walls. The upper width is measured along the line C D, which lies at a distance below the highest	The German practice conforms to the English practice in case of turret ships.

[1] Merchant Shipping Act of 1906 requires that all water-ballast tanks, except double bottoms, be measured, and if used only for water ballast, be deducted from gross tonnage.

[2] Technical directions, Art. IV, applies the same provision in Germany.

FRANCE.	ENGLAND.	GERMANY.
	point of the curved deck equal to one-third of the rise of this deck above the line A B.	

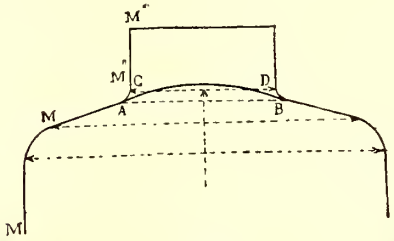


Fig. 6.

In the case illustrated by fig. 7 (a self-trimming trunk vessel), where there are sharp angles between the sides and deck, as at A and B, instead of curves as in fig. 6, and where the sides forming the trunk join the deck at a sharp angle, as at F and G, the tonnage deck is taken to be A B, and the upper width is taken along the line C D, which lies at a distance equal to one-third of the rise of the arc (A E B) below E, between the points where C D intersects the walls M A and N B prolonged.		This case is never met with in Germany. The custom would probably conform to the English custom if it did arise.

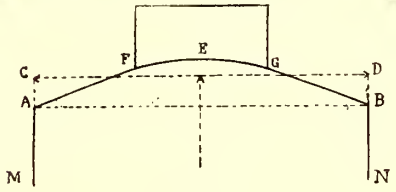


Fig. 7.

SUBDIVISION OF THE DEPTH AND MEASUREMENT OF THE WIDTH.

In a new case which just arose in England (May, 1905) a method of measuring differing somewhat from that previously employed was followed. The case was that of a new type of ship, a half section of which is represented in the figure below. (Fig. 8.)

The section was divided into three parts CC′B′D, BB′A′A, AA′D′D, the divid-

FRANCE.

ENGLAND.

ing lines between the parts being taken at points where abrupt bends occurred in the frames of the ship. The area of the portion of the section corresponding to water-ballast space AHCB was not measured, this space being considered as not available for merchandise, provisions, or fuel.

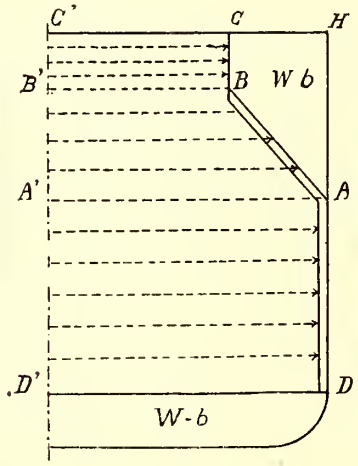


Fig. 8.

In part AA′D′D the widths were taken between the inner faces of the ribs, but in parts CC′B′B and BB′A′A they were taken to the interior face of the sheathing, forming the inner partition of the water-ballast space.

In part BB′A′A, therefore, the space corresponding to the depth of the ribs was included in the measurement.

GERMANY.

CALCULATION OF AREAS.

In all three countries the areas of the sections are calculated in accordance with the Moorsom system, which is simply an application of the parabolic rule.

When the depth has been subdivided into an odd number of subdivisions (5 or 7) the area of the section is the sum of two parts which are calculated separately in the same way. The first part comprises the upper four or six subdivisions, the second part comprises the lower part which has been itself divided into four new subdivisions.

FRANCE. | **ENGLAND.** | **GERMANY.**

CALCULATION OF THE PRINCIPAL VOLUME.

The volumes are calculated in accordance with the rules of the Moorsom system.

When, because of irregularity of bottom lines, a fictitious bottom line is assumed, it is necessary to add to the principal volume thus calculated, the volume of the neglected spaces lying below the fictitious bottom line, and to deduct the volume of the water-ballast spaces above this line, that are not deducted by the method of taking the measures (peaks and deep tanks), and are not suitable for carrying merchandise, provisions, or fuel.

The volumes of these spaces are calculated by the formula of the Moorsom system for spaces bounded by curved surfaces.

When, because of the irregularity of the bottom lines, the principal volume has been divided up into several sections, the volume of each section is calculated independently, and their sum gives the total volume.

This method of measurement, itself, eliminates the spaces between the ribs and frames, as well as the water-ballast spaces (peaks, deep tanks, and side-water ballast), which have been recognized as useless for the transportation of merchandise, provisions, or fuel.[1]

MEASUREMENT OF BREAKS.

When there is a break in the tonnage deck, the volume of this break is measured in accordance with the rules of the Moorsom system.

MEASUREMENT OF BETWEEN-DECK SPACES.

The length of a between-deck space is measured at half height and is divided into equal parts, in accordance with the tables which in each country regulate the subdivisions of the length of the tonnage deck.

At each point of division the width of the space is measured at half height. These measurements of the width are subject in each country to the same special rules that regulate the measurement of widths in determining the principal volumes. By applying these widths in the parabolic formula, the area of the between-deck spaces is obtained, and the product of this area multiplied by the mean height gives the volume of the space.

MEASUREMENT OF SUPERSTRUCTURES.

When the superstructures are of any geometrical form, the corresponding geometrical rules are applied in their measurement. When the superstructures are bounded by curved surfaces, the same procedure is followed as is followed in measuring between-deck spaces, but the length is divided into only two subdivisions. The width is therefore measured at only three points.

[1] Calculation of the principal volume.—Great Britain: The Merchant Shipping Act of 1906 provides that any water-ballast tanks other than double bottoms be deducted from gross tonnage if used only for water ballast. This means that such water-ballast spaces are first included in gross tonnage. Germany: Provision the same as in England. (Technical Directions, Art. IV.)

FRANCE.

When the length is such that the measurement of the width at three points is not sufficient to give a reasonably close approximation, a greater number of subdivisions is made. This matter is left to the judgment of the surveyors.

In the case of a poop round at the after end, the width measured nearest the stern is zero or very small. The width is therefore measured at a greater number of points in order to secure a sufficiently close approximation.

ENGLAND.

In England only three widths are taken no matter what may be the length of the space to be measured.

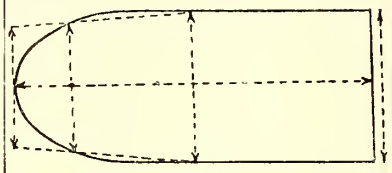


Fig. 9.

In the case of a poop round at the after end, the width at the stern is zero or very small. In lieu of this value of the width the width of the poop at the height of the sternpost or at the rudder chock is used. (Fig. 9.)

In the case of a very short poop aft round at the after end, where the width, if taken as above across the sternpost, would be taken on almost the same line that the middle width is measured on, the width nearest the stern is measured midway between the sternpost and after end of the poop, as in Germany. (Fig. 10.)

GERMANY.

In Germany the practice is the same as in England.

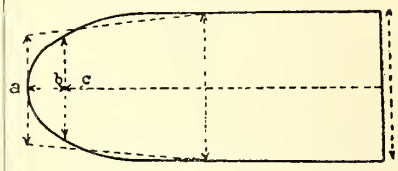


Fig. 10.

In the case of a poop round at the after end, they take for the width at the stern the width midway between the sternpost or rudder chock and the after end of the poop. (Fig. 10.)

In Hamburg they take the sternmost measurement across the sternpost, and in the case of a very short poop, where this measurement would be on almost the same line as that on which the middle width is taken, they take two-thirds of this value for the sternmost width.

ENGLAND.

In England a special rule is followed in measuring the turret of a turret ship. Although this deck space extends over the entire length of the ship, it is not measured as a between-deck space, but as an ordinary deck space.

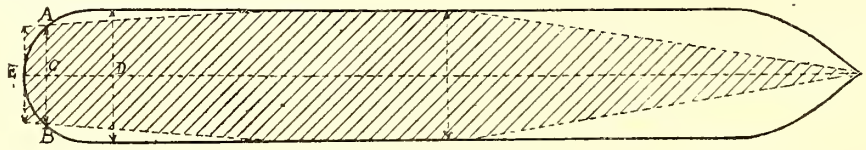


Fig. 11.

The width at the bow is frequently zero, and the width at the stern is also frequently the same. Instead of applying the rules given hereinbefore for the measurement of poops round at the after end the procedure is as follows: The width is measured along the line AB, which, measuring from the stern, is one-third of the distance of the line through D from the stern. From the line through D the turret commences to diminish in width toward the stern. The width so determined is used as the width at the stern. Thus, instead of measuring the exact surface of the turret only the portion that is hatched in the figure, which is noticeably small, is measured.

FRANCE.	ENGLAND.	GERMANY.

In France there has as yet been no occasion to measure turret ships. In Germany the English custom has been adopted.

Whenever it is necessary superstructures are subdivided into parts which are measured independently, either by the proper geometrical rule or by the special rules prescribed for the measurement of spaces bounded by curved surfaces.

II.—*Spaces exempt from measurement.*

1. Spaces Located below the Tonnage Deck.

The spaces below the tonnage deck exempt from measurement are: First, spaces between the ribs and floor beams, which are always exempt no matter what their purpose may be; second, water ballast spaces[1]; the water ballast spaces which are not exempt under the preceding category are exempted only under certain conditions; these spaces must be available exclusively for their intended purpose. They must not be suitable for cargo, fuel, or provisions. Peaks and deep tanks for water ballast must not have openings in them larger than an ordinary sized manhole, and their tops or ceilings must not rise more than a foot above the water line. These various spaces are exempted by the methods used in taking measurements, as already explained. There is some little uncertainty in the matter of side water ballast spaces, but these will doubtless be treated in the same way as bottom water ballast spaces, as they become more general.

2. Spaces Above the Tonnage Deck.

(*a*) spaces exempt on account of not being closed-in spaces.

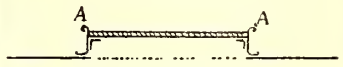
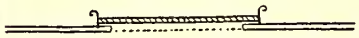
It is necessary to distinguish between two classes of openings—those in the decks covering a space, that is, hatches; and openings in the partitions and sides.

hatches.[2]

In France the matter is of small importance, since under the law all superstructures are regarded as closed. No limit is placed on the dimensions.	In England no dimensions have been definitely laid down for hatches to give a space the character of an open space. In practice the length must be at least 4 feet. The width must be equal to half the width of the ship, or to the width of the nearest freight hatch.	In Germany a hatch must be at least 6½ sq. m.; where it is double, each hatch must be at least 5 sq. m.
Strakes of a height of 0.15 m. are allowed.	Strakes of a height of 12 inches are allowed.	Strakes of a height of 0.15 m. are allowed.
There must not be any fixed and permanent means of closing.	These hatches must not have any visible means of being closed, such as exterior cleats to which a tarpaulin might be fastened in order to cover these openings. Exterior angle irons such as AA (fig. 12) to support modern hatch covers are authorized; and likewise an arrangement such as shown in fig. 13,	There must be no visible means of closing, although the arrangement shown in fig. 13, as allowed in England, is also permitted in Germany.

[1] Water ballast spaces; See note 1, p. 363, for provisions in England and Germany.

[2] Hatches: In Germany (Technical directions, Art. I) the distance of the aft side of the opening in the aft part of the shelter deck from the after surface of the sternpost must not be less than one-twentieth and the distance of the fore side of an opening in the forward part of the shelter deck must not be less than one-fifth of the standard length of the ship. The clear breadth of the openings must be at least equal to the breadth of the aft normal loading hatch on the shelter deck. The clear length must not be less than 1.22 meters (4 feet). No coaming should be higher than the surface of the iron or the wooden deck by more than 0.3 meter (12 inches). Openings must be only provisional or temporary. They may be fastened by means of eyebolts and rope lashings in the interior of the deck openings, but clamps screwed or riveted on the coamings are prohibited, as also are iron or wooden hangers. Covers may not be battened down, and rail supports riveted to the coaming may not be placed so as to be available for battening purposes. The size of openings in the outer sheathing is not specified, but is decided in particular instances.

FRANCE.	ENGLAND.	GERMANY.
	where the deck extends beyond the edges of the hatch so as to provide supports for hatch covers.	
	 Fig. 12.	
	 Fig. 13.	
Scuppers are required but there are no exact rules as to their size or number. There must be at least one on each side situated at the most advantageous point for carrying off the water.	There must also be in the space considered at least one scupper, on each side, 2 by 2 feet, or 18 by 12 inches. Ordinary scuppers are required, but in practice they are always of the kind that can be closed.[1]	A sufficient number of scuppers are required (opening to be not less than 0.08 m.) They can not be obturating scuppers.[2]
OPENINGS IN THE SIDES.[3]		
These openings, when no means of closing them are provided, give a space the character of an open space, provided there are scuppers in it.		There are no definite rules on this point.[3]
OPENINGS IN PARTITIONS.[4]		
U-shaped irons are the only permissible method of closing.	U-shaped irons are the only permissible method of closing. At times, however, the presence of holes for closing bolts in the partitions around the circumference of openings is overlooked.	The only means of closing partitions are U-shaped irons.[4]
A binding strake must not exceed 0.45 m. In order to make a space an open space, there must be one opening in the axis, or two in the sides. One lateral opening is sufficient if scuppers exist.	A 2-foot binding strake is allowed. Two lateral openings, each 3 feet wide, classify a space as open; or one middle opening 4 feet wide. If there are scuppers, one lateral opening is sufficient.	Binding strakes of 0.5 m. are allowed. A space is not classified as open unless there are two openings at least 1.42 m. in length and 0.72 m. wide.

[1] A single hatch fulfilling these conditions suffices to exempt all of the between-deck space of a shelter deck, provided the openings in the partitions in this between-deck space fulfill the prescribed requirements. In accordance with the latest English instructions to surveyors (September, 1905) this single tonnage hatch in a shelter deck ought, also, to fulfill the following requirements: Minimum length inside, 4 feet; width at least equal to that of the cargo hatch on the same deck; distance of the after side of this hatch from the sternpost, at least one-twentieth the length of the ship, as given in the ship's papers.

[2] Scuppers and ports: On each side there must be at least one water port of not less than 0.38 by 0.51 meter (15 by 20 inches). For fixing the trapdoor swinging outward, a ring bolt with rope gasket is allowed; and a single cross in the opening to prevent objects from falling through is permitted. There must be at least one scupper with cross section not less than that of a circular surface of 9 centimeters diameter. Arrangements for closing scuppers are not permitted; but in case of larger scuppers, back valves are permitted. (Technical directions, art. I.)

[3] Openings in the sides: The regulations in Germany are as in case of shelter-deck openings, except that iron plates are permitted as provisional covers for openings in bulkheads. Scuppers and ports are necessary. (Technical directions, art. II.)

[4] Openings in partitions: In Germany there must be at least one opening in one of the end bulkheads on each side of the ship. Its clear width must be at least 0.91 meter (3 feet); clear height at least 1.22 meters (4 feet); sill, if present, not over 0.61 meter (2 feet) above deck, it may be provisionally closed, but no permanent doors or other permanent means such as bolt holes, door hinges, etc., are permitted. Provisional covers may be held down by means of hook bolts which encircle angle irons, or iron cross pieces laid loosely across the opening. No battening material may be used. If only one opening is provided, then a sufficient number of scuppers and ports, of the kind defined for shelter decks, are necessary on each side. (Technical directions, art. II.)

FRANCE. | ENGLAND. | GERMANY.

(*b*) CLOSED SPACES EXEMPT BECAUSE OF THEIR PURPOSE—WATER BALLAST.

Spaces for water ballast above the tonnage deck are very unusual. They are always included in measuring the tonnage.

One case, however, has arisen in England, to which a special rule has been applied.

CASE IN WHICH WATER-BALLAST SPACE ABOVE THE TONNAGE DECK IS EXEMPT.

At the point A the rib bends toward the interior. The section is divided into three parts. (Fig. 14.)

C′CBB′, B′BAA′, A′ADD′.

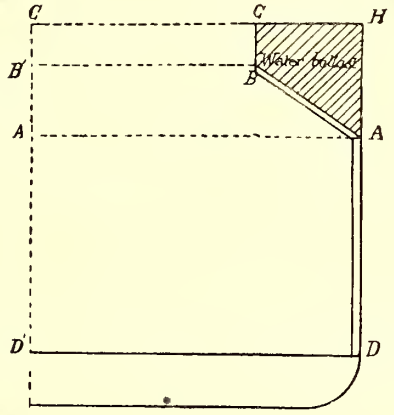


Fig. 14.

In the lowest part the measurements are taken to the inner faces of the ribs; in the middle part to the face of the inner sheathing of the water-ballast space; and similarly in the upper part. As a consequence, the water-ballast space is exempted.

All other spaces above the tonnage deck exempted because of their purpose must also be above the upper deck.

MACHINERY SPACES.

All spaces for machinery above the upper deck are always exempted subject to the following conditions:

(1) AUXILIARY BOILER SPACE.

This is exempt when on the upper deck; but if the auxiliary boiler is in any way connected with the working of the propelling machinery the shipowner may have it included in the gross tonnage, and then deducted as part of the engine-room space.

FRANCE.	ENGLAND.	GERMANY.

(2) SPACES FOR VENTILATING ENGINE ROOM.

If located on the upper deck, even on a closed bridge, they are exempt, unless the shipowner demands that they be included entirely or partly in the gross tonnage, and then deducted as engine-room space. In England and France the measurement is subject to certain conditions. (See later under "Deductions for machinery").[1]

SPACES USED IN NAVIGATING.

They are all exempt, except the chart room, which is always measured and then deducted. They include the pilot's room, the turrets for standing lights, shelters for lookouts (they sometimes include the lockers for running lights), the wheel room, and the spaces for the capstan and hoisting machinery.

SHELTERS FOR PASSENGERS ON SHORT VOYAGES.[2]

The use to be made of these spaces is not considered. The only question is whether they are closed or open.	Exempted after examination.	Same practice as in France.[2]

TOILETS.

If located on the upper deck, they are exempt. Those for the use of passengers are exempt at the rate of 1 for every 50 passengers, provided the total does not exceed 12.

KITCHENS AND DISTILLING APPARATUS.

Exempt from measurement in all three countries, if they are located on the upper decks.

BAKERY.[3]

Not exempt, unless it is in the same place as the galley.	Exempt in England since 1905, if it is located on the upper deck and furnished with ovens.	Not exempt.[3]

COMPANIONWAYS.

Exempt in all three countries. Any part of the space used as a smoking room is not exempt.

The entire volume of the circumscribed parallelopipedon is exempt. Any portion used for any other purpose is not. Nothing is exempted for them in between-deck spaces.	One-half of the circumscribed parallelopipedon is exempted, provided no portion is used for any other special purpose. England appears to extend this exemption to companion ladders in the between-deck space next below the upper deck.	The companionways are not exempt unless situated between decks. At Bremen they must also be inclosed by partitions, in order not to violate the principle that no deduction nor exemption is to be made for any space lying within a measured space, unless it is itself effectively separated.

[1] Spaces for ventilating engine room: Measurement is now also subject to restrictions in Germany. (See note, p. 373.)

[2] Shelters for passengers on short voyages: In Germany (Ship measurement ordinance, art. 13Bb) they may be exempted upon authorization of the Bureau of Registry. Same practice as in England.

[3] Bakery: In Germany (Technical directions, Art. III) bakeries equipped with ovens are now exempted.

FRANCE.	ENGLAND.	GERMANY.

SKYLIGHTS AND DOMES.

These are exempt in all three countries. Quite frequently, as shown in the figure, an opening is left in the floor of a superstructure below a skylight in order to ventilate and light the dining saloon.

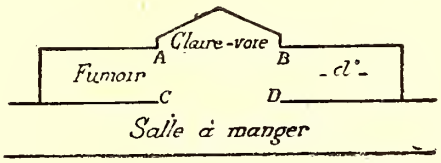


Fig. 15.

In this case they exempt not only the skylight, but also all of the space ABCD, on the ground that it is essential for lighting and ventilating the dining saloon. At Bremen, however, this is not done, by reason of the principle laid down in connection with companionways.

HATCHES.

They are exempt up to one-half per cent of the gross tonnage in all three countries.

III.—*Deductions.*

The general principle is that nothing is deducted unless it has been previously measured in determining the gross tonnage.

There are two classes of deductions: First, general deductions, exact volume of the spaces considered under this heading being deducted. Second, deductions for machinery, to a reasonable extent.

1. General Deductions.[1]

These deductions are not subject in France to the same conditions as in England and Germany. The custom of indicating by inscriptions the purpose for which spaces to be deducted are intended to be used is recommended.	All these deductions in England and Germany are subject to the condition that deducted spaces must be exactly appropriate to the purpose for which they are intended, and of reasonable size, and must bear an inscription stating for what they are to be used.

(*a*) crew space.[2]

The term "crew" includes the entire personnel on the ship's rolls—sailors, firemen, mechanics, petty officers, officers, doctors, stewards, and other personnel for the care of passengers.

The spaces for the use of crew are the rooms, lavatories, bathrooms, toilets, wardrooms, and passages exclusively serving these spaces.

In England the deductions of rooms for the crew spaces are conditioned upon their having certain dimensions, in the interests of hygiene and ventilation.	Certain hygienic conditions similar to those in England will probably be laid down in the near future, and the deductions for crew space will be subject to these conditions.

[1] General deductions: Water ballast tanks, other than double bottom, used solely for water ballast, are deducted in England and Germany. (See note 1, p. 363.)

[2] Crew space: Regulation of July 2, 1905, fixes the minimum dimensions of sleeping rooms on German vessels, and regulates ventilation, light, heat, dampness, foul odors, entrances, and other matters concerning the hygiene and comfort of the crew.

FRANCE.	ENGLAND.	GERMANY.

TOILETS FOR CREW.[1]

	These are subject to certain similar hygienic rules.	

In all three countries they are deducted only when located below the tonnage deck. If above, they are exempted.

PASSAGEWAYS.

In France and England they are deducted only when they exclusively serve only deducted spaces.		In Germany the treatment is the same; but when they serve deducted spaces other than crew spaces they are not deducted.

CREW'S GALLEY.

The galley intended solely for the crew, below the upper deck is deducted. Above this deck it is exempted.	The galley, even when intended for the exclusive use of the crew, is not deducted when below the upper deck. When above, it is exempted.	Same rules as in France.

The distilling apparatus when below the upper deck is not deducted in any of the three countries.

CAPTAIN'S QUARTERS.

In all three countries they are deducted, except such portion as could also be used by passengers.

(*b*) SPACES USED IN NAVIGATING THE SHIP.

It has already been stated that those located above the upper deck are exempted, except the chart room. Those that are deducted are the following:

SPACE FOR THE STEERING MECHANISM.

If located below the upper deck there is deducted: The space actually occupied by the steering gear and necessary for its operation. In Bremen, however, pursuant to the principle heretofore noted, this space must be inclosed.

SPACE OCCUPIED BY THE CAPSTAN AND HOISTING MACHINERY.

It is deducted when located below the upper deck, which is very unusual. At Bremen the same rule is applied as mentioned above.

CHART ROOM.

The room for charts and navigation instruments is not exempted when above the deck, but is deducted wherever it is located. When it does not exist, and the charts are kept in some measured space, a deduction of 3 Moorsom tons is allowed.

[1] Toilets for crew: Regulation of July 2, 1905, regulates the hygienic conditions of toilets, bath, and wash rooms on German vessels.

FRANCE.	ENGLAND.	GERMANY.
BOATSWAIN'S STOREROOM.		
A deduction up to 1 per cent of the gross tonnage, but not more than 75 tons, is allowed.	The deduction in England must not exceed 1 per cent of the gross tonnage for large ships—ships of more than about 1,000 tons—or 2 to 2½ per cent for others. In the case of ships of about 1,000 tons, a percentage between 1 per cent and 2 per cent is taken in order to allow for the change.	The limits are not fixed. They are about three-fourths of 1 per cent of the gross tonnage; a little more for small ships. Only one storeroom is deducted. At Hamburg the percentage varies in accordance with the following table: ¾ per cent for a ship of 4,000 tons or more. 1 per cent for a ship of from 1,000 to 4,000 tons. 2½ per cent for a ship of from 500 to 1,000 tons. 4 per cent for a ship of from 50 to 500 tons. 6 per cent for a ship of 50 tons or less.
The storeroom, as in England, may be divided into several rooms, or there may be several storerooms in different parts of the ship.	There may be several different storerooms.	

AUXILIARY BOILER.

It is deducted if situated below the upper deck and is used to operate the principal pumps of the vessel.

SAIL ROOM.

In each of the three countries it is deducted in sailing vessels with a maximum of 2½ per cent of the gross tonnage.

2. Deductions for Propelling Machinery.

When the volume of the propelling machinery is between 13 and 20 per cent of the gross tonnage for vessels with propellers and between 20 and 30 per cent for vessels with paddle wheels, a fixed deduction of 32 and 37 per cent, respectively, of the gross tonnage is allowed as the deduction for propelling machinery. When the volume of the propelling machinery is above these limits, 75 per cent of its volume for vessels with propellers and 50 per cent for vessels with paddle wheels is added to the actual volume to obtain the deduction.[1]

In France the owners can demand the actual deduction, comprising both the volume of the machinery and that of the bunkers, with a maximum of 50 per cent of the gross tonnage.	However, in England and Germany the deduction of 32 or 37 per cent may be allowed even in case of vessels whose machinery spaces are less than 13 or 20 per cent of the gross tonnage. In fact, that never occurs.

The process of measuring is the same in the three countries. The volume of the propelling machinery is measured under several heads: Principal volume (machinery and boilers), volume of ventilating spaces and of the shaft tunnel.

[1] In England and Germany the vessel owner is given a choice between the Danube rule and the Board of Trade rule for vessels the volume of whose machinery space is above these limits. In case of vessels whose machinery space is below these limits the Danube rule is applied unless the Board of Trade or Bureau of Registry, respectively, permit the application of the Board of Trade rule.

FRANCE. | ENGLAND. | GERMANY.

PRINCIPAL VOLUME.

It is measured from the ceiling, which is usually formed by a deck. When the ceiling is curved the depth is taken from the point A, at the height where the curve stops (fig. 16).

In France the principal volume can not rise above the

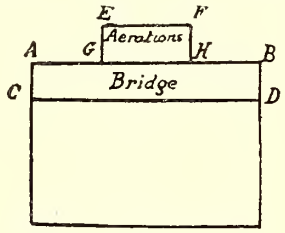


Fig. 17.

upper deck. The portion in excess is treated like the ventilation spaces.

In fig. 17 the space ABCD is treated like the space EFGH.

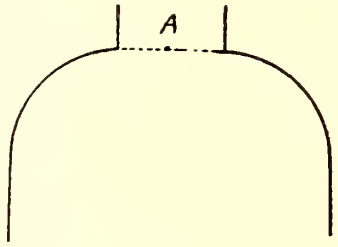


Fig. 16.

In England and in Germany the principal volume can, on the contrary, rise above the upper deck.

When the principal volume consists of several distinct parts, they are measured separately.

In France there are no restrictions as to the dimensions of the engines or boilers.

The dimensions of the engines and boiler rooms are subjected to rather strict limits in England.

When the boilers are placed longitudinally, the length of the space left for handling the fires can not exceed the length of the grates plus 1 foot.

When the boilers are placed transversely on each side of the vessel, the stoking space being in the middle, the width of the space should not exceed 11 feet. In either case the remaining space of the boiler room should not exceed what is necessary for the accommodation of the boilers.

The engine and the boilers should be separated from each other only by the distance necessary for the proper operation of the former.

Finally, the rear bulkhead of the engine room should not be more than 4 feet from the rear cylinder or its valve chest.

In Germany there are no such restrictions. It is merely prescribed that only the space necessary for the operation of the engine and the boilers will be measured.[1]

[1] Dimensions of engine and boiler rooms: Instructions to the ship survey, art. 16, sec. 3, provide that if firing is done longitudinally the length of space for handling can not exceed the length of the grates plus 30 centimeters. When firing is done transversely, the width of the stoking places should not exceed 3.5 meters.

Technical directions, Art. VII, limits the engine room and boiler rooms to what is exclusively occupied and necessary for effective operation. The rear bulkhead of the engine room should not be over 4 feet from the rear cylinder or its valve chest unless the bureau of registry permits a greater space.

FRANCE.	ENGLAND.	GERMANY.
Certain auxiliary machinery, which forms no part of the motive machinery, is often situated in the engine room. The same is true of the machine shop.		
In France the volume of the machine shop is considered as engine-room space, and is added to the latter even when it is situated in a separate place.	In England the shop is in no case considered as part of the volume of the propelling machinery.	
Auxiliary machines—dynamos, distilling apparatus, refrigerating machinery—are not theoretically regarded as part of the engine volume; but, in fact, when there is no real separation they are often included in the engine volume.	Auxiliary machines are considered as part of the engines when there is no real separation.	In Germany shop and auxiliary machinery are included in the engine volume when there is no real separation. An open bulkhead does not constitute real separation.

VOLUME OF VENTILATING SPACES.[1]

The part of the ventilators under the upper deck is always considered part of the engine space. The part situated above is wholly, or partially, added thereto only when the owner demands it; the surplus, if any, is exempted.		
The addition, in whole, or in part, of the ventilators to the engine space is, in France and in England, subject to special rules.		
In France, the width must not exceed half of the greatest interior width of the vessel. The excess is not measured.	In England, the ventilators must be necessary for the operation of the machinery, and must protect the machinery openings against the sea, and be reasonable in size. By reasonable in size is meant that their width must not exceed half of the greatest interior width of the vessel and that their length must not extend beyond the forward and rear bulkheads of the engine room. Lacking these conditions the space would be simply exempted.	In Germany, the rule requires that this space be reasonable in extent. In practice no attention is paid to this restriction.[1]

VOLUME OF THE SHAFT TUNNEL.[2]

It is everywhere and always understood that in the engine space there is included one or more tunnels.		
In France no provision is made therefor.	The English instructions provide for the very rare case where the shaft is not in-	No provision is made therefor in Germany.[2]

[1] The length of light and air shafts on German ships (Technical directions, Art. VI) must not exceed the length of the engine and boiler spaces. If a part of the deck-plated over reaches into the air shaft, the length of this part is deducted from the length of the shaft which lies in this deck. The width of the air shafts must not exceed one-half of the largest interior breadth of the ship. This limitation does not hold in the case of small ships requiring greater widths.

[2] Provisions in Germany are now the same as in England. (Technical directions, Art. V.)

FRANCE.	ENGLAND.	GERMANY.
	closed in a tunnel. A space would be deducted, corresponding to the normal sized tunnel on a vessel of the same dimensions. In particular, allowance would be made for tunnel space around the thrust block, of space sufficient for a man to remove the thrust block cap, not exceeding 7 feet in height. In the case of twin-screw vessels there would be included as tunnel space all the space about the shafts for a height not exceeding 6 feet, not including any portion that might be used for another purpose.	

The appearance of a new kind of marine engine—turbines—raises the question as to whether the deductions for engine space should not be modified. Although exact information on this space is still lacking, it seems that, for equal power, the volume of turbine engines does not differ materially from that of ordinary engines. The coal consumption also seems to be about the same. Therefore, a change in making deductions for the machinery seems scarcely probable. Moreover, potent reasons tie the hands of Governments and prevent their remedying the anomalies, recognized by all and platonically condemned for a long time, that encumber the measurement rules.

APPENDIX IX.

COMPARATIVE ANALYSIS OF THE PROVISIONS OF THE TONNAGE CERTIFICATES ISSUED TO VESSELS IN FRANCE, ENGLAND, AND GERMANY.

APPENDIX IX.

COMPARATIVE ANALYSIS OF THE PROVISIONS OF THE TONNAGE CERTIFICATES ISSUED TO VESSELS IN FRANCE, ENGLAND, AND GERMANY.[1]

TONNAGE CERTIFICATES.[2]

FRANCE.	ENGLAND.	GERMANY.
The French tonnage certificates give in detail the gross tonnage, the deductions, the net tonnage, and the spaces exempted from measurement.	The certificates of the British registry give in detail the gross tonnage, the deductions, the net tonnage, and the spaces exempted from measurement.	The German tonnage certificates give in detail the gross tonnage, the deductions, and the net tonnage.
The details of the gross tonnage comprise the principal volume, the volumes of the 'tween decks and the various superstructures measured.	The details of the gross tonnage comprise the principal volume under the tonnage deck, the volumes of the 'tween decks, and the various superstructures measured.	The details of the gross tonnage comprise the principal volume, the volume of the 'tween decks, and the various superstructures measured.
The details of the deductions comprise the volume of the propelling machinery and the related deductions, the volumes of the various spaces for the crew and officers, the spaces used in handling the vessel, and the volume of the captain's accommodations.	The details of the deductions comprise the volume of the propelling machinery and the related deductions, the volumes of the various spaces for the crew and officers, the spaces used in handling the vessel, and the volume of the captain's accommodations.	The details of the deductions comprise the volume of the propelling machinery and the related deductions, the volumes of the various spaces for the crew and officers, the spaces used in handling the vessel, and the volume of the captain's accommodations.
The details of the exemptions comprise an enumeration of the deck spaces exempted because of their special uses, and also the deck spaces exempted because of being open.	The details of the exemptions comprise an enumeration of the inclosed deck spaces exempted because of their special uses, and also, on the back of the certificate, the deck spaces not measured because of being open.	At present no exemption is mentioned. However, a decision has apparently been reached to mention the deck spaces exempted because of being open.[3]
This certificate lacks to be complete and to permit a ready check in every case, the details of the volume of the propelling machinery, and mention of the exempted water ballast spaces.	This certificate lacks to be complete and to permit a ready check in every case, the details of the volume of the propelling machinery, and mention of the exempted water ballast spaces.[4]	This certificate lacks to be complete and to permit a ready check in every case, the details of the volume of the propelling machinery, and mention of the exempted water ballast spaces.[4]

[1] Translated in 1911 by Lieut. C. Garlington, C. E., from "Etude Sur le Juageage," by V. Beret, *Controleur-Adjoint de la Navigation de la Compagnie Universelle des Canal Maritime de Suez.* Paris, 1905.

[2] Tonnage certificates: German certificates now show the spaces on or above the upper deck considered open and therefore exempted from measurement. The exempted spaces detailed in the British certificate are only those above the upper deck, but include closed as well as open spaces.

[3] The latest German certificates mention these spaces.

[4] Since 1906 and 1908, respectively, no water ballast spaces, except double bottoms, are exempted in England and Germany.

FRANCE.	ENGLAND.	GERMANY.
INTERNATIONAL TONNAGE.[1]		
Tonnage certificates made according to the English rules are accepted without verification. Those made according to other rules are verified.	The tonnage given in the papers of the vessels of the following countries: United States, Germany, Norway, France, and Denmark are accepted in England as conformable to English tonnage in all its details. Spanish vessels are remeasured in England. Italian, Swedish, and Dutch certificates often mention, in addition to the national tonnage, the tonnage calculated according to the English rules, and this is then accepted as correct. The tonnage in Russia, Finland, Belgium, Greece, Sweden, and Holland differs from English tonnage only in the method of calculating the deduction for propelling machinery. Captains of vessels of these nations can ask for the measurement of the propelling machinery according to the English rules; and the national tonnage, modified accordingly, is then accepted in England.[2]	In spite of certain existing differences the tonnage of the following countries are accepted without reservations: England, France, Austria-Hungary, Norway, Denmark, Holland, Russia, and the United States. The tonnage certificates of Italy, Sweden, and Belgium are different, but the ship's papers on board the vessels of these powers often mention their tonnage calculated according to the English rules by the officials of their own country. The tonnage so calculated is accepted in Germany.
ACCURACY OF TONNAGE MEASUREMENTS.		
The personnel that makes the tonnage measurements in France is not, as a rule, specialized in the service. In addition, it is small and poorly organized. For lack of personnel the central administration in Paris has had to give up the graphical verification of the tonnage measurements.	In England and Germany the personnel charged with tonnage measurements is specialized in this service. It is well organized and of sufficient numbers.	
All dimensions are measured to the nearest centimeter.	In England all measurements are made in feet and decimal fractions of a foot to the nearest hundredth.	All dimensions are taken to the nearest centimeter.

[1] International tonnage: Italian certificates have been accepted in Great Britain since May 11, 1906.
[2] The British Board of Trade rule for deducting power space was adopted in Holland in 1899 and in Russia in 1900.

FRANCE.	ENGLAND.	GERMANY.[1]
The subdivisions of lengths and depths are calculated to the nearest millimeter. All tonnage calculations are carried out to the third decimal and the results stated to the nearest second decimal.	The subdivisions of the lengths and depths are calculated to the third decimal. Results are stated to the nearest second decimal place.	

APPROXIMATION OF TONNAGE MEASUREMENTS TO ACTUAL CUBICAL CONTENTS.[2]

The method of measuring the principal volume in France gives in certain cases a closer approximation than in England and Germany because of the greater number of subdivisions of the length. Moreover, the method of the fictitious bottom line is a more delicate refinement than the method followed in England and Germany, in case the bottom line is irregular.	In this regard, because of the smaller number of subdivisions of the length, the English tonnage gives, in certain cases, an approximation not so close as that of the German and French methods.	Because of the number of subdivisions of the length, the approximation of the German tonnage is intermediate between that of the French and that of the English tonnages.[2]
In the case of the ceiling of a concave double bottom where the lowest width is zero the French method is inferior to the English method. The error that results may attain 5 per cent below the real area of the corresponding cross section. (English Commission of 1881.)	The method of subdividing the principal volume at each point of a break in the bottom line is easy and practical to handle. In the case of the ceiling of a concave double bottom the approximation of the English and German methods is better than that of the French methods.	
The French method exempts the volume corresponding to the thickness of the floor joists on which the bottom sheathing sometimes rests. This thickness may reach from 15 to 20 cm.	This method of measuring the areas of cross section in separate parts in all cases where the old method seems insufficient is apparently becoming more general. The volume corresponding to the thickness of the floor joists on which the bottom sheathing sometimes rests is not exempted from measurement.	
In case of refrigerating walls the deduction of the sheathing from the measurement is generally less than the deduction of the 3 inches allowed, in this case, in England.	The deduction of 3 inches from the width in case of refrigerating walls is greater than what is generally allowed in France in this case.	No deduction is made in this case. The German method is therefore, on this point, the strictest of the three.
	The special method of measuring the first width of the principal volume of turret ships is characterized by a	

[1] Accuracy of tonnage measurements: In Germany all calculations are carried out to the third decimal place, and when the fourth decimal is five or more the third is increased by one. (Instructions to ship survey, art. 26.)

[2] Approximation of tonnage measurements: German measurement practice now divides the length into the same number of subdivisions as in England. (Ship-measurement ordinance, art. 6.)

FRANCE.	ENGLAND.	GERMANY.
	diminution of the calculated area of the cross section that may reach nearly 5 per cent of the actual area.	
In the case of long vessels, the French method, because of the greater number of subdivisions of the length is of a closer approximation than the English and German methods for the measurements of the 'tween decks.	In the case of long vessels, the approximation of the English method for the measurement of the 'tween decks is less close than that obtained in Germany or in France.	In the case of long vessels, the approximation of the measurement of the 'tween decks is closer than in England and less close than in France.[1]
The approximation of the measurement of the superstructures is closer than in England or Germany, because of the measurement of a greater number of widths, whenever the length is at all considerable, or when the first width is zero.	As regards superstructures, the English and German approximations are less close than that of the French method whenever the length is at all considerable, or when the first width is zero, or very small.	

The exemptions from measurement of the water ballast spaces are governed by the same rules in the three countries. The approximations of the tonnage measurements are therefore, on this point, in very close accord.[2]

The exemptions from measurement of the inclosed spaces on the upper deck likewise conform to the same rules in the three countries. Therefore there can result, on this point, no difference in the approximations of the tonnage measurements.

The definitions of the open-deck spaces are a little stricter than in England. Some differences might result therefrom. But it must be observed that with the present subsidy laws an effort is made to avoid open spaces rather than otherwise.	The exemption from measurement of the deck spaces considered open is subject to less strict rules in England than in Germany or in France. This greater indulgence may, in some cases, have as its consequence supplementary exemptions.	The definitions of the open-deck spaces are more strict than in England. From this there may result, in some cases, less importance in these exemptions.
Crew space is deducted without any restrictions.	The deductions for crew space are subject to hygienic conditions. As it never occurs that these are not fulfilled, no difference results.	It is proposed to subject the deductions for crew to hygienic conditions.[3]
The deductions for spaces used in handling the vessel are subject to restriction only as regards the boatswain's storeroom and the sail room, with practically no difference from the English and German rule.	The deductions for spaces used in handling the vessel are subject to the condition that these spaces be reasonable in extent and exactly appropriate to their purpose. There results practically no difference from the French rule.	

[1] See note 2, p. 379.

[2] Since 1906, and 1908, respectively, water ballast spaces other than double bottom are not exempted in England and Germany. They are measured, and, if used only for water ballast, are deducted.

[3] Deductions for crew space in Germany are subject to detailed provisions as to hygienic conditions. (Regulations of July 2, 1905.)

FRANCE.	ENGLAND.	GERMANY.
The deductions for propelling machinery are subject to the same restrictions as in England only as far as ventilation spaces are concerned. The absence of precise restrictions for the other machinery volumes might, in certain cases, allow their being enlarged beyond what is necessary and thus obtaining, by the application of the "Danubian increment rule," machinery deductions greatly in excess of the real needs of the case.[1]	The deductions for propelling machinery are subject to several restrictions, having as their object the prevention of the enlargement of the machinery spaces beyond what is reasonable, and also the prevention of thus obtaining, by the application of the "Danubian increment rule," deductions greatly in excess of the real needs of the case.[1]	The deductions for propelling machinery are subject to no precise restrictions. In certain cases considerable exaggeration in the machinery spaces may result from the application of the "Danubian increment rule," causing machinery deductions much greater than is necessary.[1]
	However, these restrictions seem to only partially fulfill their object. A commission appointed by the Board of Trade is at present examining the whole question of machinery deductions. Possibly the result will be the establishment of a maximum.[2]	
The deduction of the actual volume of the coal bunkers might, in certain very rare cases, constitute an important advantage for the French tonnage rules.	The deduction of the actual volume of the coal bunkers not being applied in England or in Germany, there might result, in certain very rare cases, a considerable disadvantage as compared with the French tonnage rules	

[1] It should be added that in the absence of restrictions equally great exaggeration may result from the application of the Board of Trade percentage rule. Ordinarily the Danube rule deducts less than the Board of Trade rule.

[2] The Merchant Shipping Act of 1907 fixed a maximum of 55 per cent of the gross tonnage remaining after the general deductions are made.

APPENDIX X.

REPORT OF THE INTERNATIONAL TONNAGE COMMISSION, SIGNED AT CONSTANTINOPLE, DECEMBER 18, 1873

APPENDIX X.

THE REPORT OF THE INTERNATIONAL TONNAGE COMMISSION ASSEMBLED AT CONSTANTINOPLE IN 1873.

The international commission which has met at Constantinople, in pursuance of the invitation addressed by the Government of his imperial majesty the Sultan to the maritime powers, has taken for its guidance the circular dispatches of the imperial Government to their agents abroad, dated, respectively, January 1 and August 13, 1873, and the vizirial letters addressed to his highness the Khedive of Egypt of July 12 and 30, 1873, as well as the instructions of the Sublime Porte to their delegates. It has devoted 21 sittings to the discussion of the questions submitted to it, and has followed the rules of discussion which it had previously laid down, as shown in the procès verbaux annexed to this report.

In fixing the order of its labors the commission has thought it advisable to abide by the suggestions of his imperial majesty's Government, contained in the letters addressed to the powers and in the instructions given to the Ottoman delegates.

These documents recommended the investigation in the first place of the best mode of ascertaining: First, the total and the utilizable capacity of a ship; and second, as a consequence thereof, the examination of the scale of dues as now levied by the company on the Suez Canal. The commission, following this order of ideas, divided its work into two distinct parts, viz:

1. Question of tonnage generally.
2. The question of the tolls on the Suez Canal.

Taking the first point, and considering it in all its aspects, the commission classified it under two principal headings—gross tonnage, net tonnage.

The commission presents as follows the reasons which determined its opinion on that part of its labors: It is a traditional usage of all maritime countries to submit merchant vessels to a measurement, the result whereof, known under the general name of "tonnage," serves as the basis of the taxation to which a ship is or can be made liable everywhere and under any circumstances. The fixing of tonnage appertains in every country to the sovereign power as one of the attributes of public authority. Although this was originally determined in every state according to local convenience, yet the different systems of the various maritime countries tended toward a common rule, and gradually, as maritime commerce increased, the special privileges reserved to vessels of individual nations under their navigation laws gave way to international competition.

"Displacement," with a unit of weight and the supposed equivalent in volume, was the main principle of the old rules of tonnage for determining what a ship could carry or contain. But experience has shown everywhere the impossibility of determining by a fixed and invariable rule, in a constant manner, the carrying power of a ship, which necessarily varies according to the nature, the form, and density of each of the component parts of a cargo, as well as according to the season, state of the weather, and the respective length of voyages. It is, on the contrary, always possible to measure exactly the internal capacity of a ship, and to deduct therefrom, in a practical way, the spaces which manifestly can not be utilized for carrying freight. The different enactments on this subject, after passing through analogous stages of experiments and study, have all arrived at this result. Happily, in spite of the variety of the processes employed, the

efforts to establish, under nearly similar conditions, a comparative statistic of the maritime tonnage of the different nations have at last proved successful. If the same rules of measurement are everywhere adopted, just comparison between ship and ship will be effected satisfactorily, and shipping will be everywhere taxed after an uniform and equitable mode.

This unification of tonnage may be realized by adopting a formula combining the three following conditions, viz:

1. That of causing the internal capacity of a ship to be measured with all the precision that geometrical science is practically capable of.

2. That of expressing this capacity in tons the unit of which is obtained by a common divisor which best embodies for all maritime countries the ancient traditions of their common experience, and which gives as quotient a mean of all the varying conditions under which ships are employed.

3. That of disallowing, in determining the net tonnage which is to be the basis of taxation, any other deduction of space but that which can not be used for earning freight by being employed for carrying passengers or merchandise.

The commission has considered whether it would not be better to suppress the name of "ton of measurement" in order to avoid the continual confusion between this ton and the different tons of weight or volume employed in trade, but, after patient deliberation, it has formed the opinion that the time has not yet come when such a change in the usages of the commercial and maritime world can be recommended, and it has decided to adopt as unit of measurement the ton of capacity of Moorsom's system, viz, of 100 English cubic feet or 2.83 cubic meters.

The international commission, after laying down these principles, acknowledged that the process of measuring the capacity of ships established in the United Kingdom by the Merchant Shipping Act of 1854, under the name of Moorsom's system, realizes best the conditions required to determine gross tonnage, and agreed that no other system can better secure the application of the precise rules of deduction which are to determine the net tonnage, nor lend itself with greater advantage to the unification of tonnage at which the commission is seeking to arrive.

It is further recognized:

1. That such is the opinion of the maritime powers, inasmuch as Germany, Austria-Hungary, Denmark, the United States of America, France, Italy, Norway, and Turkey have successively adopted Moorsom's system, with slight variations in its application, and Belgium, Spain, Holland, and Sweden intend, as it has been declared by their respective delegates, shortly to adopt it.

2. That as regards the net tonnage of steamships the enactments of the English law of 1854 are not all that could be desired, inasmuch as for a class of vessels whose engines occupy a certain proportion of the total capacity the deduction is one of a percentage of the gross tonnage, whilst in other ships the deduction is derived only from the space occupied by the engines.

3. That there exists two other systems under which deductions are made, and that the difference between these two consists in the mode of dealing with the coal bunkers. The first regards movable bunkers, and is governed by the Danube rule; the other regards fixed bunkers, and is adopted in Germany, Austria, France, and Italy. Under the first of these systems a shipowner is free to employ his ships for commerce generally throughout the world, increasing or diminishing the space applicable for coals according to the requirements of each voyage, whilst by the other system he is obliged to adopt fixed bunkers inapplicable for cargo, and which can only hold coals for a certain duration of voyage. Considering that the opinions are divided upon the respective advantages of these systems, the commission recommends for the acceptance of the maritime powers the modes of procedure hereinafter contained, and the rules of measurement annexed to the present report.

If these recommendations be adopted, it would be desirable that ships' papers should contain all details of measurement, the calculation by which gross tonnage has been found, and the deductions for determining net tonnage allowed. In any case where, in the measurement of the total capacity of a ship, any exceptions have been allowed, such exceptions ought to be mentioned in her papers.

In discussing and fixing the rules of measurement annexed to this report, the commission has been guided by the following considerations, which it also submits to the approbation of maritime powers.

SECTION 1. Every trading ship, whatever may be her nationality, ought to be furnished with a certificate of registry declaring (*a*) the gross tonnage, expressing her total capacity, and (*b*) the net tonnage, giving her capacity after the deduction made of space recognized as unavailable for earning freight.

SEC. 2. This certificate of registry delivered by the competent Government authorities filled in from measurements effected in accordance with the rules proposed by the international commission shall be officially recognized in every country as the true basis for the application of ship's dues and taxes. These dues and taxes shall invariably be applied to the net tonnage of a ship.

SEC. 3. Gross tonnage is best arrived at by Moorsom's system, as defined by the rules of measurement adopted by the commission and annexed to this report.

SEC. 4. Gross tonnage comprehends the measurement of the whole space below the upper deck, as well as all spaces comprised within permanent constructions above that deck, which are covered and closed in. (For the definition see the annexed rules of measurement.)

SEC. 5. To determine net tonnage the deductions from gross tonnage are: (1) General deductions applicable alike to sailing and steam vessels; (2) special deductions applicable to steamers only.

SEC. 6. General deductions refer (*a*) to the accommodation of the crew (stewards and passengers' servants are not to be considered as part of the crew); (*b*) to officers' cabins (the captains' not included therein); (*c*) to cook houses and closets exclusively for the use of the crew, situated either above or below the upper deck; and (*d*) to covered and closed-in spaces, if there are any, on the upper deck, employed for working the ship. These spaces are to be measured separately, and the sum of them deducted. The sum total of these deductions is, however, in no case to exceed 5 per cent of the gross tonnage, but this percentage may be distributed among the several spaces according to the practice and requirements of different countries. Besides the above-named spaces it was proposed in the commission to deduct further spaces occupied by the captain's cabin, the sail room, and other places used for stowing ropes and other gear; but these latter deductions were not approved by an absolute majority of votes.

SEC. 7. The commission recommends the abolition of any system by which the net tonnage of a steamer would be derived from a percentage on her total capacity.

SEC. 8. Deductions special to steamers relate (*a*) to the engine room and boilers; (*b*) to the shaft trunk in a screw ship; and (*c*) to permanent coal bunkers. The spaces *a*, *b*, and *c* to be accurately measured.

SEC. 9. If the ship has not permanent bunkers, or if she has only lateral bunkers, and her coal is stowed in bunkers shut off from the hold by movable partitions, then the spaces of these lateral and temporary bunkers are not to be measured. In this case the rule to be applied is that in force on the Danube, namely, an allowance is made for the coal space by giving 50 per cent of the space occupied by the engine in a paddle-wheel steamer, and 75 per cent in a screw steamer. (See art. 16 of the rules annexed.)

SEC. 10. Ships furnished with permanent bunkers may nevertheless be measured under the Danube rule. In this latter case the net tonnage will be fixed according to the rules of the above paragraph.

SEC. 11. In no case (except that of tugs) shall the total of these special deductions of steamships exceed 50 per cent of the gross tonnage.

SEC. 12. For tugs when used exclusively as tugs, the special deductions may be made without any limit for space actually occupied by the engine room and coal bunkers.

SEC. 13. Provisionally, and until all the Governments have adopted uniform rules for net tonnage, and with the object of attaining in the meantime a certain uniformity of practice, a

special certificate may be delivered to any steamer by the competent authority of the country to which she belongs, which certificate shall be recognized officially in foreign ports as establishing the net tonnage upon which dues are to be paid.

SEC. 14. In those countries which have adopted Moorsom's system, the above-named special certificate shall be prepared at pleasure either according to the rule applicable to ships with fixed bunkers, or according to the Danube rule.

SEC. 15. In countries where Moorsom's system has not yet been, but will be adopted, steamers may be measured under rule 2 of the Merchant Shipping Act of 1854, with the factors 0.0017 and 0.0018. From the gross tonnage thus found the special deductions given by the above sections 6 to 12 shall be made.

The annexed special certificate as specified in section 13 shall state the gross tonnage and the net tonnage of the ship, such net tonnage to be determined at pleasure either according to the rule applicable to ships with fixed bunkers, or according to the Danube rule.

SEC. 16. Open vessels are not comprised within the proposed international rules of measurement.

SEC. 17. It is recommended that a penal provision shall be enacted to the effect that if any of the permanent spaces which have been deducted shall be employed either for the use of merchandise or passengers, or in any way profitably employed for earning freight, that space shall be added to the net tonnage, and never more be allowed as a deduction.

The provisions of the above paragraphs embrace the principles which have guided the commission throughout its labors, and it now desires to express the wish that in order to guarantee in all countries the identical application of those principles, the rules of measurement proposed by it should be adopted either by diplomatic action or by commissioners furnished with full powers, who should come to an understanding upon the means to be employed for putting those rules into execution, and on all necessary details.

The commission in approaching the second part of its duties has had, in accordance with the terms employed by the Ottoman Government in their instructions to their delegates, to resolve the following question: Is the system now actually being applied for the levying of dues in the Suez Canal in harmony with the provisions of the act of concession and of the imperial firman according to the interpretation given to those documents by the two vizirial letters addressed to his highness the Khedive?

After having examined the act of concession and the documents above mentioned, the commission opened the discussion thereon, and having successively listened to the observations of the delegates of Germany, Austria, Spain, Great Britain, Greece, Italy, Holland, Russia, and Turkey, was called upon to deliberate upon a form of resolution presented by the delegates of Great Britain (see the procès verbaux, Nos. 13 to 16). But before taking a vote on this resolution the commission received in its sitting of December 9, through its president, communication of a letter of the same date addressed to him by his excellency Raschid Pasha, minister for foreign affairs. In deference to the recommendation contained in that letter the commission discussed and adopted officially an opinion in the following form, which was accepted unanimously, and which the commission hopes is in harmony with the desire expressed by the Sublime Porte.

OPINION.

Being invited by the Sublime Porte to express an opinion upon the system of levying dues on the Suez Canal under the concession, the firman of 1866, and the vizirial letters of the 17th Djémazi-ul-Ewel and 6th Djémazi-ul-Ahir 1290, and in conformity with the desire expressed in his excellency Raschid Pasha's letter of December 9, 1873, referring on the one hand to the act of concession of the Suez Canal, which concession is to remain untouched, and on the other hand referring, with a view to the application of the provisions of that act, to the general principles and rules of measurement already laid down by the international commission, the commission is of opinion that the dues to be levied in the canal may be regulated by an arrangement upon the following bases:

SHIPS MEASURED ACCORDING TO MOORSOM'S SYSTEM.

1. A surtax of 4 francs, in addition to the tax of 10 francs, shall be levied per net register ton on steamers whenever the deductions due to engines have been determined under section *a* of Clause XXIII of the Merchant Shipping Act of 1854 defining Rule III.

2. This surtax shall be reduced to 3 francs for every vessel which shall have inscribed upon her papers or annexed to these papers the net tonnage based on the system recommended by the international commission, which shall form the basis for the levying of the tax and the surtax.

3. It is to be understood that ships already measured according to the alternative system suggested by the commission, and particularly those under paragraph *b* of the above-named clause of the Merchant Shipping Act of 1854, shall be liable from the present time to only a surtax of 3 francs per ton of net register, provided always that the deductions for engines and fuel shall not exceed 50 per cent of the gross tonnage.

VESSELS MEASURED UNDER ANY SYSTEM OTHER THAN THAT OF MOORSOM.

4. Gross tonnage of ships not measured under Moorsom's system shall be brought into accordance with that system by the application of the Danube scale of factors, and their net tonnage shall be determined according to section *a* of the above-named Clause XXIII of the Merchant Shipping Act. These vessels shall pay, over and above the tax of 10 francs, a surtax of 4 francs per ton on their net tonnage.

PROVISION COMMON TO ALL SHIPS.

5. The surtax of 3 francs per net register ton shall be progressively reduced in the proportions hereinafter specified according to the development of the annual tonnage of ships passing through the canal, and shall cease altogether so soon as the said tonnage shall have reached in any one year 2,600,000 net register tons, when the original maximum tax of 10 francs per ton only shall become applicable.

The above-named diminution of the surtax shall be on the following scale: So soon as the net tonnage shall reach 2,100,000 tons within one year the company shall levy in the following years the surtax of $2\frac{1}{2}$ francs only.

When the net tonnage shall have reached 2,200,000 tons within one year, the year following the surtax shall not exceed 2 francs per ton, and so on; so that each successive annual increase of 100,000 tons shall entail a successive diminution of 50 centimes of the surtax for the year following, and when during any one year the net tonnage shall have arrived at 2,600,000 tons the surtax shall be entirely abolished, and the original tax not exceeding 10 francs per ton shall be reverted to.

It is further to be understood (*a*) that whenever the increase of net tonnage within any one year shall exceed 100,000 tons the surtax during the year following shall be diminished by 50 centimes per ton in respect of each excess of 100,000 tons; (*b*) that once the surtax shall have been diminished or abolished as provided above no increase or reimposition shall be allowed even if the amount of net tonnage passing through the canal should fall off; and (*c*) that January 1 (new style) shall be taken as the commencement of each year for the purposes of the surtax.

TRANSPORTS, VESSELS OF WAR, AND VESSELS IN BALLAST.

6. Vessels of war, vessels constructed or chartered for the transport of troops, and vessels in ballast shall be exempted from all surtax; these shall pay no higher dues than the maximum tax of 10 francs per net register ton.

After the commission had expressed the above opinion in its nineteenth meeting, the first delegate of Turkey made the two following declarations, having been thereto authorized by his Government:

1. That the authority to levy a surtax of 1 franc given to the company in 1871 for a special purpose is withdrawn; and

2. That no modification for the future, of the conditions for the passage through the canal shall be permitted, whether in regard to the navigation toll or the dues for towage, anchorage, pilotage, etc., except with the consent of the Sublime Porte, which will not take any decision on this subject without previously coming to an understanding with the principal powers interested therein.

The delegates of Great Britain, Italy, Spain, Belgium, Austria-Hungary, Germany, Turkey, France, Greece, and Russia declared at the twentieth meeting of the commission that they were authorized by their Governments to accept the provisions of the arrangement hereinbefore contained. The delegates of Holland declared that they were likewise so authorized by their Government, but under the reserves which they have already made on certain points.

This report is drawn up and signed at Constantinople this day, December 18, 1873 (28th Chewal 1290).

(Signed)

For Germany—
GILLET.
HARGREAVES.
For Austria-Hungary—
G. DE KOSJEK.
L. ZAMARA.
E. F. NICOLICH.
For Belgium—
CAM. JANSSEN.
For Spain—
JOACHIM TOGORES.
A. RUATA.
For France—
A. D'AVRIL.
RUMEAU.
For Great Britain—
J. STOKES.
PHILIP FRANCIS.
For Greece—
A. A. H. ANARGYROS.
For Italy—
E. COVA.
F. MATTEI.
ALEX. VERNONI.
For Holland—
JANSEN.
RICHARD S. KEUN.
For Russia—
B. E. STEIGER.
KORCHIKOFF.
For Sweden and Norway—
O. VON HEIDENSTAM.
For Turkey—
EDHEM.
M. SALIH.
H. MADRILLY.

The Secretary, CABATHEODORY.

APPENDIX XI.

HISTORY OF THE MEASUREMENT OF TONNAGE OF VESSELS USING THE SUEZ CANAL.

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APPENDIX XI.

HISTORY OF THE MEASUREMENT OF TONNAGE OF VESSELS USING THE SUEZ CANAL.[1]

The franchise of the Suez Canal Co. authorized it to collect a maximum toll of 10 francs ($1.93) per "ton of capacity" from all vessels passing through the canal. This toll was to be the same for every class of ship and was to apply without discrimination to vessels of all nations. The exact meaning of the expression "ton of capacity" was not defined. During the construction period of the canal no one gave any consideration to this question.

First period (1869–1872).—In 1868, when the canal was to be opened to navigation, the canal company appointed a special commission to decide upon the various questions arising in the actual operation of the canal. This commission decided that, in the absence of any international rule for the determination of the tonnage of vessels, it would be best to base the toll to be charged on the net tonnage of ships as given by the ship's papers, without discrimination as to the flag of ships. The heart of the question relative to the ton of capacity and ton of official measurement of the various nations was not examined into.

Second period (1872–1874).—The canal company first charged tolls upon this basis. The receipts proved less than the financial necessities of the company required. An examination was then made to see if this method of charging tolls complied with the terms of the franchise. General inquiries were made and a new commission, made up of well-known and able men, was formed to go to the bottom of the matter, and to decide what standard should be used in determining the tonnage of ships. As a result of its studies, the commission decided that the English gross tonnage of ships, expressed in terms of the English standard capacity ton (100 cubic feet) was the best measure of the usable capacity of ships. In accordance with this opinion, a new tariff was put in force for the collection of canal tolls July 1, 1872.

Preliminaries to the International Commission of Constantinople.—This action gave rise to lively recriminations throughout the maritime world. The interpretation thus placed by the canal company on the terms of its franchise was violently attacked. Some Governments took up the matter in behalf of their citizens and addressed the sovereign power that had granted the franchise, with a view to obtaining an exact definition of what had been meant by "ton of capacity." The question ceased to be a scientific one, and became a diplomatic one. It is unnecessary to go into the pressure that was brought to bear on the Ottoman Porte, on both sides. Urged first one way and then the other way, the Porte decided, after a fruitless effort to settle the question himself, to refer it to an international commission to be assembled at Constantinople.

In the invitation to participate addressed to the other powers, the Porte treated the measurement of tonnage in the Suez Canal merely as a particular case of the more general problem to be submitted to the deliberations of the commission. The problem before the commission was to be "the determination of a standard ton which would serve both as a unit for commercial transactions and also as a unit on which to collect the tolls to which navigation is subject."

The principal powers made explicit reservation in taking up the program thus outlined. The delegates were instructed that the commission should limit itself to the consideration of the case as it applied to the canal company. The English Government claimed that the ques-

[1] This is Part II of a monograph on "The Measurement of Vessels," by Lieut. V. Beret, published at Paris in 1905 by the Societe Anonyme de Publications Periodiques. Part I of the monograph contains a history of vessel measurement. The translation of Part II was made by Capt J. R. Slattery, Corps of Engineers, United States Army, Nov. 10, 1911.

tion of an international method of measuring the tonnage of ships could be properly studied only by a conference held in a great maritime center, such as London, and could not be properly studied in Constantinople, where the necessary sources of information for the solution of the problem would not be available. Other nations, France, Germany, Italy, and Austria-Hungary, had just recently adopted rules for the measuring of tonnage, based on the Moorsom system, and were not disposed to change them.

International Commission of Constantinople.—Nevertheless the records of the meetings showed all the delegates, except those representing the canal company, engaged in the very work which their Government had at first refused to consider; that is, the search for an international system of measuring tonnage.

This sudden reversal of attitude is somewhat surprising, but the causes are easily discovered by a little study. It was evident that the only international system of measurement possible would be one based on the Moorsom system, as the measurement laws of all the greatest maritime nations of the world were based on this system. The program of the Porte could not be carried out if all previous ideas were ignored. Recognizing this, there was only one possible solution, i. e., a system based on the Moorsom system, freed, if necessary, from some of the imperfections which discredited it in several countries.

By treating the measurement of tonnage at Suez as the first application of the general solution, the powers would gain just the point at issue with the canal company. This plan was accordingly followed without hesitation by the delegates, who totally disregarded the contrary instructions of their Governments.

The French delegates, who in the conference, were the natural representatives of the canal company, foresaw this danger and made every effort to limit the discussion to the interpretation of the contested clauses of the franchise.

In discussing this question they were able to show without difficulty that net tonnage determined according to the Moorsom system expressed only very approximately the usable capacity of ships, and that the ton which served as a measurement unit in the Moorsom system bore but little relation to the standard ton which ought to be used in measuring the usable capacity of a ship.

In the beginning the English tonnage had expressed accurately the freight-carrying capacity of the ship. For some considerable time before the Moorsom system was adopted in place of the former method, English tonnage had ceased to do this, and the change was made so as not to change in any way the total tonnage of the British fleet. The prime consideration in selecting the value of the new ton to be used as the unit in determining the tonnage of ships was to select one that would be sure to fulfill this condition. It had no relation whatsoever to the capacity ton, nor to the ton commonly used in commercial transactions, and the tonnage which it expressed did not at all closely correspond with the usable capacity of the ships.

Despite their efforts, the commission refused to follow the French delegates in the study of the question thus raised. Faithful to their instructions which required them to restrict themselves to a search for a method of determining the usable capacity of ships, they withdrew and the conference proceeded in peace to the elaboration of rules for an international system of measurement.

It would be unjust to question the sincerity of the commission in its belief as to the value of such a work. They undertook it not only because it was the best way of defending the interests which they had to uphold, but also because they thought they were laying the foundation for a highly desirable and long desired understanding. It is nevertheless true that, from this point of view, their failure was complete, and that the International Commission of Constantinople succeeded in fixing units which apply only on the Suez Canal.

After having decided to this extent on an international system for determining tonnage, they then took up its application to the canal. The extension of the system to this special case was in their eyes the first practical application; and, according to their belief, it was going to obligate all the governments in the reasonably near future to conform to the system thus established. The commission did not hesitate to declare in a series of recitals that "by the usable

capacity of a ship, a capacity different from the net tonnage of the ship determined in accordance with the rules of the commission could not be understood," and that "the words of the franchise 'capacity tons' could not apply to a measure in pounds as the words 'of ships' excluded merchandise as a basis for collection; thus limited, the only basis left on which to collect tolls was the tonnage of the vessel."

The conclusions resulting from the recitals, had they been voted on, would have been a formal denial of the claims of the canal company. Just at this time a measure was adopted which saved the canal company from the difficulties that would have been involved in refunding the excess tolls collected under its last tariff, to wit, authority was granted the canal company to collect a surtax over and above the regular tolls authorized by the franchise. such surtax to be reduced in proportion as receipts increased.

The measure which authorized the surtax provided that tolls should be collected on the basis of net tonnage as defined by the rules just promulgated for international use in measuring tonnage. This brought about just what the conclusions of the conference would have effected had they been voted on. The recitals outlined above retained all their force, although they were not repeated in the final document which was the fruit of the commission's labors.

In 1874 the company was compelled by military force to apply the new rules.

In 1876 the rules promulgated in 1873 were finally accepted with slight modifications relating to the gradual reduction of extra charges. The interpretation of the terms of its franchise given by these rules thus acquired all the force of law. We shall now look into the consequences which followed without referring further to a case tried so long ago, and from the finding in which there is no appeal.

THE PRINCIPLES OF THE CONSTANTINOPLE RULES.

The terms of the franchise remained unchanged.

Net tonnage became the lawful measure of the usable capacity.

Net tonnage is calculated from gross tonnage by making certain deductions.

Gross tonnage includes the entire space below the upper deck, and likewise all covered and closed-in spaces above this deck. The commission formally decided against any exceptions. The measurement of these spaces was to be made according to a geometrical process laid down by the rules.

The commission, although accepting the principle of deductions, recognized very clearly the dangers which would result. It was recognized that there would be a tendency to increase the number and the amount of deductions to be made, and that frauds might be perpetrated to this end. It endeavored to guard against this double danger by establishing fixed maxima, which could not be exceeded, and by limiting and exactly specifying the spaces that could be deducted.

It recognized that in doing this it did not authorize the deduction of a number of spaces manifestly useless for carrying cargo, but it thought that the employment of such a liberal unit of measurement, as the ton adopted, would sufficiently compensate for the spaces not deducted. The commission did not formally vote on this proposition, but a number of delegates expressed this view, and it was not disputed.

Net tonnage therefore represents a capacity, part of which is not available for cargo. It is nevertheless this volume, expressed in terms of a unit equal to 100 cubic feet or 2.83 cubic meters, which gives the "usable capacity" upon which the Suez Co. is authorized to collect tolls. Every change in the rules established by the commission for determining net tonnage tends to change the relation of equivalence between this tonnage and usable capacity. It is needless to insist upon this point, since we have seen that these rules include in the net tonnage a number of spaces that manifestly can not be used.

The tendency of national legislation, on the other hand, has been to exclude in the determination of net tonnage all spaces that can not be used. In each country the net tonnage forms the basis on which navigation taxes are assessed. Each country can modify net tonnage at pleasure within limits permissible under international agreements. With the canal company

it is different. In accordance with its franchise, which remains unchanged, the usable capacity constitutes the basis for the collection of tolls. This usable capacity is expressed by the same number as the net tonnage, as long as the latter is determined in accordance with the rules laid down by the commission. The company can not make any change in these rules whatever without violating the terms of its franchise, which is its chart and compass.

In the determination of gross tonnage, no spaces can be exempted, and, in the determination of net tonnage, only the spaces specified and those only to the extent laid down by the rules can be deducted. This rule is the result of the labors of the International Commission of Constantinople.

Despite its strictness it is nevertheless subject to interpretation. It should not be lost sight of that the Constantinople rules are more than 30 years old. The progress in naval construction since 1873 has greatly modified certain characteristics of ships. Certain features designed especially to improve the seaworthiness of ships have been introduced. It has also been necessary to introduce certain reforms intended to increase the comfort of the crew.

The necessity of adjusting the Constantinople rules to new conditions has resulted in an evolution. the steps of which we shall trace.

EVOLUTION OF TONNAGE MEASUREMENTS AT SUEZ.

Rules for measurement.—The practical procedure in measurement, decided upon in 1873, has become somewhat out of date in certain cases. The number of measurements prescribed to be taken should be increased proportionately to the increase in the size of ships. Here we see one disadvantage of the inflexibility of those rules, and it is not the only one. The adoption of water ballast has resulted in the frequent appearance of ships with irregular bottom lines. Ships have also been built in which the dimensions of the hulls vary rapidly. Here again we have to acknowledge a certain failure of the rules for measurement. The application of the parabolic formula, which is the only one it is practicable to use, necessitates a sufficient number of measurements and a uniform variation in the various dimensions between points where they are taken. This applies equally to ships having irregular bottom lines and to ships varying rapidly in dimensions in certain parts. It is probable that the Constantinople commission might have provided some special rules for special cases. In fact, most nations have already introduced such into their system of measuring, and have taken it upon themselves to improve upon the Suez method of measuring. England, although she has corrected in certain particulars the methods employed in determining her own tonnage, continues nevertheless to apply strictly the Constantinople rules in measuring the tonnage for Suez navigation. Only a very approximate result is obtained in the case of rather long ships, with irregular bottom lines, or with hulls that vary rapidly in cross section at certain points. Certain types of ships profit largely as a result of this faulty approximation, particularly turret ships. Summing up all the advantages that it reaps, a turret ship of 2,500 tons net tonnage would measure up nearly 150 tons less than it would if it were measured by methods better adapted to its special case. This is an advantage amounting to nearly 6 per cent. In this matter, however, the company is absolutely bound by the letter of the Constantinople rules. These evils, which arise only in a limited number of cases, have already been eliminated by certain nations on their own accord and are of small importance.

Appearance of new usable spaces.—The general substitution of iron for wood in ships has brought with it other consequences that follow as a result of the Suez rules for the determination of tonnage.

The measurements to determine tonnage are taken on the inside of a ship along the inner faces of the frames. The volumes thus excluded, which correspond to the depth of the frames and the thickness of the decks, were formerly very small and really not usable. To-day, however, it is no longer so. The reduction in the size of scantling which the employment of steel has permitted has given to these volumes a very considerable value. Nevertheless in the great majority of cases no use is made of these spaces for commercial purposes. If, however, liquid cargoes became more frequent, or if liquid fuel came into general use, the matter

would become of considerable importance. The volumes thus excluded from measurement would become entirely available for use, and designers could increase them at will by increasing the depth of the frames and the thickness of the decks. There is not much doubt but that according to the spirit of the Constantinople rules these spaces could not be taxed.

As a rule no use is yet made of these spaces except for water ballast. This is not really a commercial use and the company has never made any objection to their use in this manner. In accordance with its customary liberal policy it has even approved this use of such spaces.

Spaces for water ballast.—Water ballast is not always carried in the space between decks. Certain compartments are sometimes especially provided for this purpose. The company, however, can not except any of these spaces unless they are excluded regularly under the rules. One exception has been made in favor of double-bottom vessels. This type was more or less in favor for a time because the system of double bottoms could be readily applied to all ships. The cellular method of carrying water ballast which has now supplanted it is entitled to the exemption of the water-ballast spaces in the double bottoms by the rules themselves. The measures taken by the company for water ballast carried, according to the MacIntyre system, were inspired by the desire not to place at a disadvantage one type of ship as compared with another.

It is not possible, however, to go further in this matter and exempt or deduct from measurement such water-ballast spaces as the peak or deep water ballast tanks, which are not excluded by the rules themselves, on the theory that they are not available for carrying merchandise, provisions, or fuel. National systems of measurement have all tended more or less to exclude such spaces. The Suez Co. can not do so. Water ballast is merely the modern substitute for the old solid ballast which ships had to take when their cargo was light, and the commission of 1873 intentionally did not exempt from measurement the space occupied by this ballast. It is one of the many spaces not capable of being used for cargo that was not excluded, but was intended to be adequately compensated for by the adoption of such a liberal unit as the Moorsom ton. This was the opinion of Sir John Stokes, who was perhaps the most influential member of the International Commission of Constantinople. In a memorandum which he addressed to the board of trade in 1879 he thus expressed himself:

> I have no hesitation in saying that the exemption of water-ballast spaces would raise a storm of opposition from the Suez Canal direction and I think that they would find no justification in the Constantinople rules which now regulate the question.

This storm of opposition which Sir John Stokes predicted did not burst, for there has never been any effort made to have exempted in the Suez measurements water-ballast spaces which are exempted under national measurement rules. The water-ballast spaces exempted under the Suez rules are exempted only because of their location. They are exempted because they are comprised within the depths of the frames or of the decks. The Suez rules absolutely cover this point. Unhappily, limits are not so well defined on some other points.

Deck spaces.—The commission of Constantinople declared that the measurements should include all spaces without any exemptions. In 1878, in the course of negotiations with the company, the English Government succeeded in having allowed a practice which practically amounted to the exemption of certain deck spaces. Skylights, companionways, and hatchways to the extent of one-half of 1 per cent of the gross tonnage were exempted from measurement. The importance of these spaces is slight in comparison with the violation of the principle of nonexemption, caused by the exemption of these spaces from the measurement for gross tonnage. It was the forerunner of a conflict which nearly destroyed this fixed principle. The controversy over deck spaces was foreseen at the beginning of the Suez system of measurement. It was in the very nature of things that it should arise. It was endeavored at Constantinople to foresee it and provide for it by the strictness of the text—a hope which was not realized. The controversy was postponed but not avoided. It arose first in the national systems of measurements, and it may be said without great error that the solutions reached in national systems were largely responsible for the raising of this question at Suez. Shipowners

encouraged by these decisions naturally wished to obtain similar concessions from the Suez Co., but were always refused. The obligations imposed upon the company by its franchise made it absolutely impossible for it to consent. To have yielded upon this point would have resulted in one special type of ship being favored.

Though the controversy would probably have arisen anyway, the exactness of the definitions which should have prevented it is not above criticism. Certainly the intention of the definitions is not doubtful, but in such matters intention is not always sufficient. Even the strictness of the text of the Constantinople conference failed to go far enough. It gave two definitions—one for open spaces and the other for closed spaces. It failed because these were exactly complementary to each other, while as a matter of fact there is a middle ground. It might have been sufficient for one of them, say open spaces, which are more clear and less subject to dispute. The company has always held that this definition represented most faithfully the intention of the Constantinople rules, and has always considered it as the exact limits of its right. The company, however, could not disregard the other definition, bound as it is by the text which is its law and guaranty, and had to take it into consideration. The definition of closed spaces is, unfortunately, much less precise, and it is in regard to its rights concerning this that all the discussions have come up. The whole question resolves itself into the establishment of a definite criterion for facility in closing the openings of the deck spaces after measurement. It is to be noted that the presence of merchandise is not sufficient exactly to determine the character of these deck spaces. The transportation of cargo on deck or deck loads in open spaces was authorized by the commission, and it has always been extremely difficult to define exactly what was meant by deck cargo. To attempt to lay down an exact criterion in this matter is to be between Charybdis and Scylla.

The question did not become acute until some time after the promulgation of the rules. This is to be regretted. The solution which would have been reached when the discussions of the Constantinople commission were still fresh in everyone's memory would have been much more in accordance with the spirit of this commission. For a number of years, however, ships had but few or no deck spaces. The evolution in naval construction, which increased more and more the importance of these structures, took place slowly. The concessions made in national systems of measurement helped to accelerate this evolution. Nevertheless, for a long time the company was called upon to consider only isolated cases and it did not treat these first cases with the strictness which it should have done. Such were the cases of the *Puttalo* in 1875, of the *Aeolus* in 1880, and of the *Penang* in 1881. Its action during this initial period was influenced by the attitude of the English Government.

In the course of the negotiations which resulted in the arrangement of 1878, the board of trade claimed the right of those Governments which had participated in drawing up the rules of 1873 to apply them as they saw fit, without regard to the company's interpretation. In a measure it claimed infallibility in this matter. It did not admit that the company could tax spaces not included in the special Suez certificate as long as these spaces had not been changed nor their use modified, simply because the company interpreted the Constantinople rules differently from the board of trade, and placed a different meaning on the words "easily closed." If all other Governments had made the same pretense as the English Government a condition of chaos would have followed in the application of the rules, since each would have had the right to interpret them in its own fashion. This would have been absolutely incompatible with the primary obligation imposed on the company by its franchise to deal equally with all flags. The situation practically carried with it the obligation of recognizing the company to a greater or lesser extent as the judge and arbitrator of the interpretation which might be made of the Constantinople rules. The Suez Co. endeavored to exercise this rôle only so far as necessary in order to maintain as complete harmony as possible with the nations which are its principal patrons. Seven-tenths of the traffic which passes through the canal sails under the English flag. An understanding with the board of trade is thus essential, and other nations must sooner or later accept the conditions to which the strongest patron of the company subscribed.

The Board of Trade seems to have recognized the danger of leaving the application of the rules of 1878 to the individual interpretation of the nations. In 1897 it even pointed out to the company certain abuses in the matter of interpretation in the case of 11 Dutch ships.

Even at this time the isolated cases of disagreement which marked the beginning of the controversy over deck spaces were beginning to increase in number. The evolution in naval construction became more marked, and the importance of these deck spaces increased. As early as 1895 the operating department of the canal noted the number of poops, bridges, and forecastles which it had found practically inclosed, although they had not been measured. In 1896 the number of these cases increased. In one of them—that of the *Baron Glamis*—the Board of Trade sought the opinion of the company. In order to do away with the friction the Board of Trade in 1897 gave new instructions to its surveyors. It laid down exactly what arrangements for closing were necessary in order to make a space a closed one.

The company soon discovered that these instructions were insufficient. It began to understand that the ingeniousness of shipowners and constructors would always find some way to get around the obstacles which they might try to impose on them in this way. Therefore the difficulties continued.

The arrangement of 1899.—In 1899, upon the advice of Sir John Stokes, one of the three representatives of the British Government in the council of administration of the Suez Canal, the operating department tried to reach a solution by laying down a rule similar to that which for a long time had existed in the English law. All the spaces excluded from measurement in accordance with the instructions of the Board of Trade of 1897 would be taxed whenever they were used for carrying merchandise.

This measure was well suited to lead to the satisfactory solution sought for, but it was absolutely contrary to the company's franchise. It substituted taxation of capacity used for taxation of capacity usable. The obligation of the company to maintain inviolate the principles of its franchise and of the Constantinople rules, which merely complement the former, compelled it to revoke this concession, which the shipowners immediately endeavored to profit by to the utmost, and was leading to manifest abuses. One of the most serious was the use of isolated deck spaces under the upper deck as a sheltered deck space without a continuous deck (case of the *South America*). Sir John Stokes himself presented evidence of the facts.

The company never sanctioned the arrangement known as that of 1899, and in reality the practice was introduced without its formal consent. The experiences of the last few years have compelled it to recognize that the ingeniousness of the shipowners and constructors would always twist and distort the definitions which it might give to closed and open spaces. It therefore insisted that no further effort in this direction should be attempted. From its point of view the only practical way of solving the difficulty was to judge whether as a matter of actual fact or not the deck spaces, under the terms of the Constantinople rules, represented an increase of carrying capacity which could be utilized for the transportation of merchandise other than deck loads. The position of the company was so sound that the Board of Trade could not fail to recognize it. Sir John Stokes, the author of the arrangement of 1899, forced them to recognize it, and the arrangement of 1902 was the fruit of his efforts.

The arrangement of 1902.—The shelter deck spaces, which had been one of the principal causes of recent disagreement, received a special treatment. The company consented to exempt from tolls those portions of shelter-deck spaces which were entitled to it because of their openings. The character of isolated deck spaces was to be judged by the company's former rules; that is, those of 1897. In the case of those which would thus be declared open, a declaration was to be obtained from the shipowners as to the use for which they were intended, and then, depending upon the use to be made of them, they were to be added to or omitted from the tonnage. But it was understood that every space not measured would always thereafter be subject to tolls if it were ever found in use.

This very important arrangement marked the return to the principles of its franchise, which the company considered to be indispensable, but it was not able to obtain those fair decisions which it regards as the only way to decide the question of deck spaces. The sur-

veyors left it to the declaration of the shipowners when a space was judged open according to the rules agreed to by the Board of Trade.

This clause contained the seed of new difficulties. It placed a premium on dishonesty among the shipowners. The company did not have to wait long to see the effects. Some ships arrived at the canal (*Poplar Branch, City of Edinburgh, Oanfa, Fullwell*) with enormous deck spaces not measured. These deck spaces had been judged open because of the arrangement of their openings, and the shipowners declared that they did not expect to make any use of them. It was a manifest abuse, but was only a temporary one, since it was only necessary that these spaces should be used a single time for them to be always thereafter taxed. The company decided, however, that it would not tolerate it, even for the time being, and the Board of Trade recognized the evil of the arrangement of 1902.

The arrangement of 1904.—A new study resulted in the elaboration of the rules of 1904, which were accepted by the Board of Trade, and were not promulgated by the company until after a conference with the French department of taxes and the German bureau of registry. Under the rules of 1904 nothing was changed in regard to the treatment of shelter-deck spaces, but the company finally obtained the suppression of the 1897 instructions, which determined whether a space was open or closed. This matter was to be left to the fair judgment of the surveyors. It was for them to decide in the light of experience and good sense whether or not a deck space could be used for transporting merchandise other than deck loads. This was what the company had always claimed, but it had to make a concession in order to accomplish this.

The arrangement of 1902 had caused rather lively recriminations in parts of the maritime world. Among the arguments made to attack this arrangement was the claim that poops, bridges, and forecastles had no other use than to contribute to the safety of the ship, and were not intended for commercial purposes. The concession agreed to by the company in order to get back to the true application of the Constantinople rules was made in order to satisfy these claims. The company agreed to exempt from tolls such poops, bridges, and forecastle spaces as were deemed necessary for the security of the ship. The surplus which could not be justly exempted for this reason was to remain subject to tolls. One consideration entirely beyond the concern of the canal company turned up to limit its liberality. The spaces which were to be exempted from tolls at Suez would have continued to be subject to tonnage taxes everywhere else, because they were closed in accordance with the English measurement. Shipowners would have had good reason to claim a similar concession from the Board of Trade. This the Board of Trade would not have been willing to grant, since it had already gone far enough in the way of concessions, although along different lines; thus it was understood that the exemption agreed to by the company in the rules of 1904 would not extend to the spaces or portions of spaces which according to the English measurement rules would be considered closed.

A few other provisions will now complete the rules of 1904 and the details of their application. The most important were intended to bring about a correspondence between the exemption agreed to in the matter of deck spaces which took the form of shelter-deck spaces and those granted in the matter of isolated deck spaces. The object of this was to avoid favoring one type of ship at the expense of another. It was with this same idea in view that the benefit of the exemption of 1904 was not granted to deck spaces which were located under those which had already profited by these rules.

The concessions thus made by the company would have been contrary to the principles of its franchise and the Constantinople rules if care had not been taken to subordinate them to one restrictive clause, to wit, that every space exempted by the rules of 1904 would always be subject to tolls from the day on which it was found in actual use for transporting merchandise or supplies. Thanks to this precaution the position taken by the company was not contrary to the principles which must always remain inviolate.

The exemption of shelter-deck spaces could be regarded as questionable exemptions. The Constantinople definitions did not clearly define the nature of a shelter-deck space nor cover openings of a certain class. In the absence of an exact criterion, a special treatment was followed, which was a compromise between the claims of the shipowners and the company.

The exemption on account of safety granted to poops, bridges, and forecastles appeared at first view the most difficult to decide. One might consider it a regular deduction by slightly enlarging the category of these "closed and covered spaces on the deck intended for use in working the ship," which the Constantinople rules permitted to be deducted, provided that they did not exceed the specified limit of 5 per cent to which all these general deductions are subjected.

One must, however, place these spaces outside of this category. They are spaces which the Constantinople commission did not foresee. In fact, in 1873 the existing ideas were based to a great extent upon experience with sailing vessels, and it was an admitted fact that such deck spaces were opposed to the security of the ships. To-day we are better informed upon this point, and the laws relating to the load water line, which have only the safety of the ship in view, consider certain amount of these spaces as favorable and take them into consideration. This is, then, a new case, and the Constantinople rules can not apply to it. In order to recognize the new conditions the company has had to consent not to a modification but to an addition to these rules.

Following the promulgation of the 1904 rules, deck spaces in England received a treatment the principal features of which may be summed up as follows:

Deck spaces are divided into three classes:

(*a*) Spaces closed in accordance with the British rules for determining tonnage;

(*b*) Spaces open under the British rules and closed under the Suez rules;

(*c*) Spaces open under the Suez rules.

The first are in every case added to the gross tonnage and not entitled to the benefits of any special exemption. It is left entirely to the surveyors to determine the character of these spaces.

The spaces of the second class are added to the Suez tonnage and are entitled to the exemption of the 1904 rules under the conditions laid down. The surveyors decide whether a space belongs to the second or third class according to the following principles:

Every space merely under a sheltering roof conforms to the Constantinople definition of an open space, and belongs to the third class. All other spaces are judged by the character of their openings. An opening in a bulkhead less than one-half the width of the space is considered easy to close. An opening in a bulkhead greater than one-half the width of the space is not considered easy to close, unless special arrangements for closing it are provided. Deck hatchways are not considered.

Spaces in the third class, so determined, are entitled to exemption as a matter of right under the Constantinople rules. It seems that the English practice rather exceeds what the rules of 1904 permitted, but the precedence which this practice created during a period of 10 months has sufficed to give it a sort of official sanction. However, these measures lead to grave abuses. The most certain abuse would be the exaggeration of poops, bridges, and forecastles provided with openings greater than one-half their width, for which, because of this fact, an exemption from tolls would be claimed. It is essential, therefore, to immediately provide an interpretation of the rules of 1904. It is possible to do this without rejecting the English practice, which has already in a way acquired the force of an established custom, by supplementing it and imposing restrictions. It is supremely important that these principles remain inviolate, to wit, that every deck space which is not a space under a simple sheltering roof may always, in accordance with the Constantinople definition of open spaces, be added to the tonnage whatever may be the nature of its openings, if, as a matter of fact, it increases the usable capacity of the ship; and if in the beginning it is not thus considered, the fact of its being used a single time for carrying merchandise is sufficient to establish its true character and to subject it to tolls. Whatever practice is followed in the treatment of deck spaces, this principle must necessarily dominate it under penalty of returning to the era of difficulties which the company has just passed through during recent years. (See Appendix XIV for British application of Suez rules in 1911.)

Deductions.—We have just seen that certain exemptions allowed by the 1904 rules must be considered as in reality deductions. The Constantinople commission classed deductions under two different headings: General deductions common to all classes of ships, and special deductions for machinery space on steamships. The application of these Constantinople rules has not caused any serious difficulties since their adoption by the company.

Arrangement of 1878.—Nevertheless, in the beginning it appeared to the English Government that the enumeration of spaces to be deducted as being exclusively intended for the crew and officers was incomplete. This question was looked into in the course of negotiations which we have already referred to in describing the right claimed by the Board of Trade to interpret the rules. The result was the agreement of 1878, by which the company agreed to allow deductions in the case of rooms for officers and petty officers, bathrooms, chart rooms, and doctor's cabin. This arrangement was merely an addition to the Constantinople rules, but did not alter any of its principles. It is in accordance with the liberal spirit which the company has always shown whenever it has been able to do so without violating the terms of its franchise or the provisions of the rules of 1873.

Deductions for crew spaces.—It has recently appeared that the agreement of 1878 imposed too low limits upon the deductions for rooms and for bathrooms. The limits correspond to the conditions then existing, but are too strict for the present day. Considerable changes have taken place since that time. The greater comforts provided for the crew have led to installations which neither the commission of 1873 nor the agreement of 1878 mentioned as among those that might be deducted. But if the text of these rules does not specify them, it, nevertheless, can not be doubted but that the deductions of these spaces conform to the spirit which inspired these rules. The time would, therefore, appear to be ripe to increase the number of spaces to be deducted as spaces intended for the crew and for the officers, and to increase the limits which the agreement of 1878 placed on some of them. The limit which the commission imposed so formally and precisely upon the total of all these general deductions must, however, remain unchanged. A study of this question shows that in a great majority of cases the permissible limit of 5 per cent of gross tonnage will not be reached by permitting the deduction of all the rooms for officers and petty officers and of all bathrooms and lavatories for the exclusive use of the crew and officers. There would, therefore, be no trouble in adopting this liberal measure, which is clearly in accordance with the spirit of the rules. It should be understood, however, that the maximum limit of 5 per cent can not in any case be exceeded.

Deductions for machinery.—The Constantinople rules have left to the shipowners the choice between two methods of deducting motive-power spaces. The commission intended not only to deduct the volume of the engine room and fireroom but also the space occupied by the fuel. This space not always being fixed, the commission permitted deductions to be determined either by measuring existing structures or by basing them upon the volume of the machinery space as indicating the volume of space to be used for carrying fuel. This is called the Danube rule of excess allowance.

It is to be remarked that fuel might be considered with some justice as true merchandise. By taking on a great quantity of fuel ships avoid the necessity of purchasing it from ports of call, and thus establish its true nature as merchandise and provisions. This point of view could not be admitted, and was not even presented before the commission, the principal care of which was to keep in harmony with the principal features of the Moorsom system, according to which such a deduction was permissible.

The application of the rules for the deduction of spaces occupied by the machinery has never caused serious difficulties. The maritime world has never attacked them. In the great majority of cases the Danube rule is applied, and one might say without exaggeration that the deduction that it permits generally considerably exceeds the space really occupied by the fuel. This possibly explains why this rule enjoys the favor of shipowners.

It is possible that the more general employment of liquid fuel may considerably change the position in this matter. The heavy petroleum oils employed for firing can be easily stored in the spaces between the frames, spaces which are exempted in accordance with the method

prescribed for measurement. To apply the Danube rule in such a case would result in deducting from the gross tonnage a volume representing spaces which did not exist—namely, spaces for fuel—and this would be manifestly absurd. The absurdity, distinctly contrary to the Constantinople rules, would result in favoritism being shown to ships using this method of firing. It would violate the essential principle of the franchise, which is equal treatment to all ships. It would not be possible to avoid this difficulty without violating one of the Constantinople rules, and it is probable that such action would have serious consequences. It is well known that in certain countries one is bound by the letter of the law in spite of the absurd consequences which might result. An example of this is the case of the *Isabella* in the history of English measurement. This contingency has happily not yet come up. The general use of liquid fuel, which has been predicted for some years, has not yet materialized. Nevertheless, it would be imprudent not to admit that this method of firing may be used much more in the future than at present. The company, therefore, must move with great prudence in this matter, and refrain from making any decision which might establish a precedent to be used against it if ever the question assumes a real importance.

During the last few years a new type of marine engine, namely, the steam turbine, has made its appearance, and promises a successful future. This brings up the question of determining whether or not the Danube rule will fit to this new case. Will the proportion of the volume of the engine allowed in determining the space occupied by fuel apply to this new class of engine? The exact information necessary in order to give a definite opinion is at present lacking, but it seems probable that the Danube rule will in this case remain sufficiently satisfactory.

Furthermore, it is to be remarked that since 1873 the ordinary type of engine has been greatly perfected; although their dimensions have been increased, the space occupied per horsepower has been decreased. The consumption of coal is proportionate to the power of the engine, and not to the space occupied by it. This evolution would have run great risk of upsetting any empirical rule such as the Danube rule, if it had not been accompanied by a corresponding reduction in the fuel consumption per horsepower. A horsepower requires much less space, but it also requires much less coal. The Danube rule is, therefore, still applicable at the present time.

Actual Suez measurement.—The study of Suez measurement from its beginning up to the present time shows that it has obeyed the law of evolution which no human institution can hope to escape; but this evolution has taken place without sensibly passing beyond the rigid limits which the franchise of the company and the Constantinople rules imposed upon the company. Thus the differences between the original system and its present application are very slight.

The principle of measuring all the spaces, which had at one time been lost sight of, has been affirmed anew, and remains practically unchanged. The method of measurement continues to give a sufficiently accurate approximation in the great majority of cases, and whenever it has failed here and there the several nations have made the necessary corrections on their own initiative. The method of measurement naturally excludes certain spaces which have become more important than formerly, but up to the present time these spaces have not been used in practice except to carry water ballast. The deductions remain within the maximum limits laid down, and these limits have proven sufficiently large to enable greater deductions to be made for crew space and to allow for the new conditions which have arisen, without departing from the spirit of the rules. The method of calculating the deductions for machinery is still satisfactory from every point of view. The method of determining the net Suez tonnage is practically the same as that established by the International Commission of Constantinople.

The legal maxim which it proclaimed, namely, that the net tonnage so determined was the best expression of the usable capacity, remains true. It may be asked if the evolution of the Suez system might not have been altogether different if the company had been left to its

own resources to resist the powerful influences which during the same time have so largely modified national systems of measurement. The Suez system of measurement, in consequence of its application solely in the canal, is in a peculiar situation. The combined influences of the entire maritime world oppose the lone interest of one company. The struggle would not have been equal if the international agreement had not given it the force and the power, which it otherwise certainly would have lacked. This is one consequence, as beneficial as unforeseen, at the Constantinople conference, the decisions of which had to be forced upon the Suez Co. by military force.

En résumé, despite some imperfections, the Suez system of measurement is certainly the most sane of all those in existence. It has the faults common to all systems, which base tonnage on volumes obtained by making certain deductions. It fully taxes the facilities for transporting volumes, and taxes the facilities for transporting weights in a more or less uncertain and generally more indulgent fashion. The limits, which have been placed upon the total extent of deductions permissible, prevent the advantage which ships especially designed for the transportation of heavy cargoes would enjoy, if their tonnage were based solely on volumes from acquiring an excessive and scandalous value. And it is impossible to obtain net Suez tonnages of zero or negative value as happens in the British registry to the great disadvantage of the companies and private corporations, whose revenues are thus collected upon a basis which is about as poor a measure as possible for the services which such enterprises render the ships. It is impossible to give an idea of the excesses to which volume measurement badly established, such as that of England, may lead. Mr. Isakson, surveyor for Lloyd's and member of the Institution of Naval Architects, prepared three plans of a ship capable of carrying 4,000 tons of heavy cargo. According to the first plan the net tonnage, British register, is 100 tons. According to the second, it is zero, and according to the third, it is negative and equal to 100 tons minus.

It is fitting to recall the words of one of the administrators of the company at the second commission of investigation in 1871.

> If, as said by a noted diplomat, speech has been given man in order to disguise his thoughts, one would be tempted to believe from the results obtained that the methods prescribed for measuring tonnage have been created in order to disguise the true tonnage.

The wisdom of the Constantinople rules and their maintenance intact, in spite of the vicissitudes of time, protects the Suez method of determining tonnage, in a great measure, from the burden of this reproach.

APPENDIX XII.

SUEZ CANAL COMPANY'S RULES FOR THE MEASUREMENT OF VESSELS.

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SUEZ CANAL COMPANY'S RULES FOR THE MEASUREMENT OF VESSELS.[1]

General Principles.

1. The gross tonnage or total capacity of ships comprises the exact measurement of all spaces (without any exception) below the upper deck, as well as of all permanently covered and closed-in spaces on that deck.

Note.—By "permanently covered and closed-in spaces on the upper deck" are to be understood all those which are separated off by decks or coverings, or fixed partitions, and therefore represent an increase of capacity which might be used for the stowage of merchandise, or for the berthing and accommodation of the passengers or of the officers and crew. Thus any one or more openings, either in the deck or coverings, or in the partitions, or a break in the deck, or the absence of a portion of the partition, will not prevent such spaces being comprised in the gross tonnage, if they can be easily closed in after admeasurement, and thus better fitted for the transport of goods and passengers. But the spaces under awning decks without other connection with the body of the ship than the props necessary for supporting them, which are not spaces "separated off" and are permanently exposed to the weather and the sea, will not be comprised in the gross tonnage, although they may serve to shelter the ship's crew, the deck passengers, and even merchandise known as "deck loads."

2. "Deck loads" are not comprised in the measurement.

3. Closed spaces for the use or possible use of passengers will not be deducted from the gross tonnage.

4. The determination of deductions for coal spaces may be effected either by the rules of the European Danube Commission of 1871 or by the exact measurement of fixed bunkers.

Rule I.—*For measuring the gross tonnage of empty vessels.*

Article 1. The length for the admeasurement of ships having one or more decks is taken on the tonnage deck, which is—

(*a*) The upper deck for vessels having one or two decks.

(*b*) The second deck from below for vessels having more than two decks.

Measure the length of the ship in a straight line along the upper side of the tonnage deck from the inside of the inner plank (average thickness) at the side of the stem to the inside of the midship stern timber or plank there, as the case may be (average thickness), deducting from this length what is due to the rake of the bow in the thickness of the deck, and what is due to the rake of the stern timber in the thickness of the deck, and also what is due to the rake of the stern timber in one-third of the round of the beam; divide the length so taken into the number of equal parts required by the following table, according to the class in such table to which the ship belongs.

Art. 2. Class 1. Ships of which the tonnage deck is, according to the above measurement, 50 feet long or under, into 4 equal parts.

Class 2. Ships of which the tonnage deck is, according to the above measurement, above 50 feet long and not exceeding 120 feet, into 6 equal parts.

Class 3. Ships of which the tonnage deck is, according to the above measurement, above 120 feet long and not exceeding 180 feet, into 8 equal parts.

Class 4. Ships of which the tonnage deck is, according to the above measurement, above 180 feet long and not exceeding 225 feet, into 10 equal parts.

[1] The Suez Company's measurement rules are the regulations for the measurement of tonnage recommended by the International Tonnage Commission which assembled at Constantinople, in 1873.

Class 5. Ships of which the tonnage deck is, according to the above measurement, above 225 feet long, into 12 equal parts.[1]

ART. 3. Then, the hold being first sufficiently cleared to admit of the required depths and breadths being properly taken, find the transverse area of such ship to each point of division of the length as follows: Measure the depth at each point of division, from a point at a distance of one-third of the round of the beam below such deck, or, in case of a break, below a line stretched in continuation thereof, to the upper side of the floor timber at the inside of the limber strake, after deducting the average thickness of the ceiling which is between the bilge planks and the limber strake. Then, if the depth at the midship division of the length do not exceed 16 feet, divide each depth into four equal parts; then measure the inside horizontal breadth at each of the three points of division, and also at the upper and lower points of the depth, extending each measurement to the average thickness of that part of the ceiling which is between the points of measurement. Number these breadths from above (i. e., numbering the upper breadth 1, and so on down to the lowest breadth). Multiply the second and fourth by four, and the third by two; add these products together, and to the sum add the first breadth and the fifth. Multiply the quantity thus obtained by one-third of the common interval between the breadths, and the product shall be deemed the transverse area; but if the midship depth exceed 16 feet, divide each depth into 6 equal parts instead of 4, and measure, as before directed, the horizontal breadths at the five points of division, and also at the upper and lower points of the depth; number them from above, as before; multiply the second, fourth, and sixth by 4, and the third and fifth by 2; add these products together, and to the sum add the first breadth and the seventh. Multiply the quantity thus obtained by one-third of the common interval between the breadths, and the product shall be deemed the transverse area.

ART. 4. The area of the transverse sections can also be measured with the same precision by the following method of polar coordinates:

Divide each transverse half section into five angular sectors, having the same angle at the apex (this angle is equal to $\frac{90}{5}$ of a degree $= 18°$), and take for the area of each of these sectors the area of the sector of the circle comprised between its extreme radii, and described by the mean radius.

In making the measurement, measure the mean radius of each sector, of which the two extreme radii would make, the one with the horizontal line and the other with the vertical line, an angle of 9°, while the others are uniformly 18° apart.

In order to obtain their directions, place on the plane of the section a semicircle properly divided, and turned so that its horizontal diameter may pass through the third of the round of the beam, and that its center may be found in the central longitudinal vertical plane of the ship; the radii are to be measured by means of a tape fixed in the center of the semicircle.

In order to calculate the area of the section, square the mean radii thus measured, add them together, and the sum multiplied by 0.31416 shall be deemed to be the area of the section.

ART. 5. Number the transverse sections measured by one of these methods successively 1, 2, 3, etc., giving No. 1 to the extreme limit of the length at the bow, and the last number to the extreme limit of the length at the stern; then, whether the length be divided according to the table into 4 or 12 parts, as in classes 1 and 5, or any intermediate number, as in classes 2, 3, and 4, multiply the second and every even-numbered area by 4, and the third and every odd-numbered area (except the first and last) by 2; add these products together, and to the sum add the first and last, if they yield anything; multiply the quantity thus obtained by one-third of the common interval between the areas, and the product will be the cubical contents of the space under the tonnage deck. The tonnage of this volume is obtained by dividing it by 100, if the measurements are taken in English feet; and by 2.83 if the measurements are taken in meters.[2]

ART. 6. If the ship has a third deck, commonly called a spar deck, the tonnage of the space between it and the tonnage deck shall be ascertained as follows: Measure in feet the inside length of the space at the middle of its height from the plank at the side of the stem to the

[1] A greater number of divisions is not prohibited so long as they are an even number.

[2] In these rules the multiplier 0.353 may be used instead of the divisor 2.83 to give meters.

lining on the timbers at the stern, and divide the length into the same number of equal parts into which the length of the tonnage deck is divided, as above directed; measure (also at the middle of its height) the inside breadth of its space at each of the points of division, also the breadth of the stem and the breadth at the stern; number them successively 1, 2, 3, etc., commencing at the stem; multiply the second and all the other even-numbered breadths by 4, and the third and all the other odd-numbered breadths (except the first and last) by 2; to the sum of these products add the first and last breadths; multiply the whole sum by one-third of the common interval between the breadths, and the result will give in superficial feet the mean horizontal area of such space; measure the mean height of such space, and multiply by it the mean horizontal area, and the product will be the cubical contents of the space; divide this product by 100, or by 2.83 if the measurements are taken in meters, and the quotient shall be deemed to be the tonnage of such space, and shall be added to the other tonnage of the ship ascertained as aforesaid; and if the ship has more than three decks, the tonnage of each space between decks above the tonnage deck shall be severally ascertained in manner above described, and shall be added to the tonnage of the ship ascertained as aforesaid.

ART. 7. If there be a break, a poop, or any other permanent closed-in space on the upper deck available for cargo or stores, or for the berthing or accommodation of passengers or crew, the tonnage of such space shall be ascertained as follows: Measure the internal mean length of such space in feet, and divide it into two equal parts; measure at the middle of its height three inside breadths, namely, one at each end and the other at the middle of the length; then to the sum of the end breadths add four times the middle breadth, and multiply the whole sum by one-third of the common interval between the breadths; the product will give the mean horizontal area of such space; then measure the mean height, and multiply by it the mean horizontal area; divide the product by 100, or by 2.83 if the measurements are taken in meters, in order to obtain the tonnage of such space.

ART. 8. In measuring the length, breadth, and height of the general volume of the ship or that of the other spaces, reduce to the mean thickness the parts of the ceiling which exceed it. When the ceiling is wanting, or when it is not permanently fixed, the length and breadth are reckoned from the frame of the ship.

RULE II.—*For measuring the gross tonnage of laden ships.*

ART. 9. When ships have their cargo on board, or when for any other reason their tonnage cannot be ascertained by means of Rule I, proceed in the following manner:

Measure the length on the upper deck from the outside of the outer plank at the stem to the aftside of the sternpost, deducting therefrom the distance between the aftside of the sternpost and the rabbet of the sternpost at the point where the counterplank crosses it.

Measure also the greatest breadth of the ship to the outside of the outer planking or wales.

Then, having first marked on the outside of the ship on both sides thereof, the height of the upper deck at the ship's sides, girt the ship at the greatest breadth in a direction perpendicular to the keel from the height so marked on the outside of the ship, on the one side, to the height so marked on the other side, by passing a chain under the keel; to half the girth thus taken add half the main breadth; square the sum, multiply the result by the length of the ship taken as aforesaid; then multiply this product by the factor 0.17 in the case of ships built of wood, and by the factor 0.18 in the case of ships built of iron. The product will give approximately the cubical contents of the ship, and the general tonnage can be ascertained by dividing by 100 or by 2.83, according as the measurements are taken in English feet or in meters.

ART. 10. If there be a break, a poop, or other permanent covered and closed-in spaces (as defined in the general principles) on the upper deck, the tonnage of such spaces shall be ascertained by multiplying together the mean length, breadth, and depth of such spaces, and dividing the product by 100 or 2.83, according as the measurements are taken in English feet or meters, and the quotient so obtained shall be deemed to be the tonnage of such space, and shall be added to the other tonnage in order to determine the gross tonnage or total capacity of the ship.

Deductions to be Made from the Gross Tonnage in Order to Ascertain the Net Tonnage.[1]

Art. 11. To find from the gross tonnage of vessels as above set forth the official, or net register tonnage, either for sailing vessels or for steamships, the following mode of operation must be resorted to:

SAILING VESSELS.

Art. 12. For sailing vessels deduct the spaces exclusively and entirely occupied by the crew and the ship's officers, those taken up by the cookhouse and latrines exclusively used by the ship's officers and crew, whether they be situated above or below the upper deck; the covered and closed-in spaces, if there be any situated on the upper deck, and used for working the helm, the capstan, the anchor gear, and for keeping the charts, signals, and other instruments of navigation.

Each of the spaces deducted as above may be limited according to the requirements and customs of each country, but the deductions must never exceed in the aggregate 5 per cent of the gross tonnage.

Art. 13. The measurement of these spaces is to be effected according to the rules set forth for the measurement of covered and closed-in spaces on the upper deck; the result, obtained by deducting the total of such allowances from the gross tonnage, represents the net or register tonnage of sailing vessels.

STEAMSHIPS.

Art. 14. For vessels propelled by steam or any other mechanical power deduct:

1. The same spaces as for sailing vessels (art. 12) with the limitation to 5 per cent of the gross tonnage.

2. The spaces occupied by the engines, boilers, coal bunkers, shaft trunks of screw steamers, and the spaces between decks and in the covered and closed-in erections on the upper deck surrounding the funnels, and required for the introduction of air and light into the engine rooms, and for the proper working of the engines themselves. Such deductions can not exceed 50 per cent of the gross tonnage.

Art. 15. The measurement of the spaces allowed for, both in sailing vessels and in steamships (sec. 1 of art. 14), is to be effected according to the rules set forth in articles 12 and 13 for sailing vessels.

Spaces for which allowances are made in steamships only (sec. 2 of art. 14) are measured according to the following rules:

SHIPS HAVING COAL BUNKERS WITH MOVABLE PARTITIONS.

Art. 16. In ships that do not have fixed bunkers, but transverse bunkers with movable partitions, with or without lateral bunkers, measure the space occupied by the engine rooms, and add to it, for screw steamers 75 per cent, and for paddle steamers, 50 per cent of such space.

By the space occupied by the engine rooms is to be understood that occupied by the engine room itself and by the boiler room together with the spaces strictly required for their working, with the addition of the space taken up by the shaft trunk in screw steamers and the spaces between decks which inclose the funnels and are necessary for the admission of air and light into the engine rooms.

These spaces are measured in the following manner: Measure the mean depth of the space occupied by the engines and boilers from its crown to the ceiling at the limber strake; measure also three, or, if necessary, more than three breadths of the space at the middle of its depth, taking one of such measurements at each end and another at the middle of the length; take

[1] Extract from the final report of the International Tonnage Commission assembled at Constantinople in 1873.

Sec. 17. It is recommended that a penal provision shall be enacted to the effect that if any of the permanent spaces which have been deducted shall be employed either for the use of merchandise or passengers, or in any way profitably employed for earning freight, that space shall be added to the net tonnage, and never more be allowed as a deduction.

the mean of such breadths; measure also the mean length of the space between the foremost and aftermost bulkheads or limits of its length, excluding such parts, if any, as are not actually occupied by or required for the proper working of the engines and boilers. Multiply together these three dimensions of length, breadth, and depth, and the product will be the cubical contents of the space below the crown. Then find the cubical contents of the space or spaces, if any, between the crown aforesaid and the uppermost or poop deck, as the case may be, which are framed in for the machinery or for the admission of light and air, by multiplying together the length, depth, and breadth thereof. Add such contents as well as those of the space occupied by the shaft trunk to the cubical contents of the space below the crown; divide the sum by 100 or by 2.83, according as the measures are taken in feet or meters and the result shall be deemed to be the tonnage corresponding to the engine and boiler room which serves as basis for the deductions referred to.

If in any ship in which the space aforesaid is to be measured, the engines and boilers are fitted in separate compartments, the contents of each shall be measured separately in like manner, according to the above rules, and the sum of their several results shall be deemed to be the tonnage of the engine rooms which serves, as aforesaid, as basis for the total deductions.

SHIPS WITH FIXED COAL BUNKERS.

ART. 17. In ships with fixed coal bunkers, measure the mean length of the engine and boiler room, including the coal bunkers. Ascertain the area of three transverse sections of the ship (as set forth in the rules given in arts. 3 and 4 for the calculation of the gross tonnage) to the deck which covers the engine. One of these three sections must pass through the middle of the aforesaid length, and the two others through the two extremities. Add to the sum of the two extreme sections four times the middle one, and multiply the sum thus obtained by the third of the distance between the sections. This product divided by 100, if the measurements are taken in English feet, or by 2.83 if they are taken in meters, gives the tonnage of the space in question. If the engines, boilers, and bunkers are in separate compartments, they are separately measured, as above set forth, and the results are added together.

In screw steamers the contents of the shaft trunk are measured by ascertaining the mean length, breadth, and heighth, and the product of the multiplication of these three dimensions divided by 100 or 2.83, according as the measurements are taken in English feet or in meters, gives the tonnage of such space.

The tonnage of the following spaces between decks, and in the covered and closed-in erections on the upper deck, is ascertained by the same method, viz: (*a*) The spaces framed in round the funnels. (*b*) The spaces required for the admission of light and air into the engine rooms. (*c*) The spaces, if any, necessary for the proper working of the engines.

ART. 18. Instead of the measurement of fixed bunkers, the rules for bunkers with movable partitions as set forth in article 16 may be applied.

ART. 19. In the case of tugs the allowances are not limited to 50 per cent of the gross tonnage; all the spaces occupied by machinery, boilers, and coal bunkers may be deducted. Nevertheless, if such vessels are not exclusively employed as tugs, the deductions in question can not exceed 50 per cent of the gross tonnage.

ADDITIONAL DEDUCTIONS ALLOWED BY THE SUEZ CANAL COMPANY.

The company allows the following spaces to be included in the deductions specified at article 12 of the regulations for the measurement of tonnage, provided the deductions do not, in the aggregate, exceed 5 per cent of the gross tonnage:

(*a*) The chart room, even when also used as the captain's cabin. When, however, the captain's accommodation comprises several rooms, one of which is the chart room, that room alone is deducted; but, in all cases, the room used as the chart room, must, if it is to be deducted, be situated on the upper deck.

(*b*) Cabins of the ship's doctors, if actually occupied by them.

(*c*) A mess room, if there is one, for the exclusive use of the officers and engineers; or, if they exist, two mess rooms, one of them for the exclusive use of the officers, the other one for the exclusive use of the engineers. A mess room, if there is one, for the exclusive use of the petty officers. No deduction is allowed for the officers' mess room in ships having passenger accommodation, which are not also provided with a passengers' mess room.

(*d*) All spaces fitted as bathrooms, or lavatories, for the exclusive use of the ship's officers, engineers, and crew, with the exception of such of the said bathrooms as is available for passengers when no bathroom for their exclusive use is provided.

(*e*) All spaces specially provided for the storage of electric searchlights and wireless telegraphy appliances, on condition that they are situated on the upper deck.

The above specified spaces can only be deducted if they bear a distinctly visible and permanent indication of their exclusive appropriation.

MEASUREMENT OF DECK SPACES.

For vessels fitted with superstructure the following rules,[1] which concern only such spaces as are excluded from the national tonnage, are applied:

I.—*Ships with one tier of superstructures only.*

1. *Poop, bridge, forecastle.*—The following exemptions are allowed:

(*a*) Such length of the poop measured from the inside of the stern timber, at half height of the said poop, as shall be equal to one-tenth of the full length of the ship.

(*b*) The portion of the bridge in way of the air spaces of the engine and boiler spaces, it being understood that such air spaces are not considered to extend beyond the forward bulkhead of the stokehold and the after bulkhead of the main engine room.

(*c*) Such length of the forecastle measured from the inside of the stem at half height of the said forecastle, as shall be equal to one-eighth of the full length of the ship.

(*d*) In each of the above three cases of superstructures, such portions in the walls of the ships as are in way of openings not provided with any means of closing and corresponding to one another.

2. *Poop and bridge combined, or forecastle and bridge combined.*—In each of these combined spaces the following exemptions are allowed:

(*a*) That length only which corresponds to the openings of the engine room and boiler spaces as specified in (*b*) above.

(*b*) Such portions as are in way of openings not provided with any means of closing and corresponding to one another.

3. *Shelter decks.*—In the case of shelter decks the portions in way of openings not provided with any means of closing and corresponding to one another. Such air spaces as are situated within the shelter deck must be measured into the engine-room space and deducted together with 75 per cent of their volume.

II.—*Ships having more than one tier of superstructures.*

(*a*) The exemptions prescribed in paragraphs 1, 2, and 3, above, are applicable in their entirety to the lower tier only.

(*b*) Tiers above the lower tier are only allowed the exemption of such portions as are in way of openings in the side plating of the ship not provided with any means of closing and corresponding to one another.

REMARK.

Should a vessel at any time transit with merchandise of any kind, or bunker coal, or stores of any description, in any portion whatever of any exempted space, the whole of that space is added to the net tonnage and can nevermore be exempted from measurement.

[1] Supplementary rules added in 1904.

APPENDIX XIII.

MEMORANDUM BY THE UNIVERSAL MARITIME CANAL COMPANY OF SUEZ ON THE APPLICATION OF THE RULES OF 1904 RELATIVE TO THE MEASUREMENT OF SUPERSTRUCTURES.—PARIS, 1909.

APPENDIX XIII.

MEMORANDUM BY THE UNIVERSAL MARITIME CANAL CO. OF SUEZ ON THE APPLICATION OF THE RULES OF 1904 RELATIVE TO THE MEASUREMENT OF SUPERSTRUCTURES.

PARIS, 1909.

A. DEFINITION OF THE VARIOUS SPACES ABOVE DECK.

In making out the special tonnage certificate of the Suez Canal, the superstructures to be considered are the following:

1. *Isolated spaces.*—Poop, bridge, and forecastle.

2. *Combined spaces.*—Extended poop and extended forecastle.

If the poop and forecastle are united by a continuous roof or deck and by walls likewise continuous to the bridge, the spaces thus united constitute, according to definition, a combined space—extended poop in the first case, and extended forecastle in the second case. A complete break either in the roof or walls reverts the case to the category of isolated spaces.

3. *Shelter deck.*—The three spaces united into one constitute a shelter deck.

The superstructures may have a single tier or several tiers. The treatment applicable to the first tier is not the same as that applied to the others, and each tier is to be measured separately.

B. DETERMINATION OF THE DECK SPACES TO WHICH THE RULES OF 1904 APPLY.

Under the Rules of 1904, for the determination of Suez tonnage, the spaces hereunder defined are divided into three categories:

First category: Spaces or portions of spaces *closed in* according to national measurement rules.

These spaces are always included in Suez tonnage; the Rules of 1904 are not applicable to them.

In determining whether or not a space is in this category the Suez Canal Co. accepts the judgment of the national surveyors. Since the Rules adopted in the different countries for the determination of national tonnage are considered as practically identical, the treatment of a space is the same for Suez tonnage whatever may be the flag of the ship.

Second category: Spaces or portions of spaces *open* according to Suez measurement rules and national measurement rules.

These spaces are not included in the special tonnage certificate of the Suez Canal Co.; the Rules of 1904 are not applicable to them.

According to the Rules of the Commission of Constantinople, the spaces of the second category are:

The spaces under awning decks without other connection with the body of the ship than the props necessary for supporting them, which are not spaces "separated off" and are permanently exposed to the weather and the sea, will not be comprised in the gross tonnage, although they may serve to shelter the ship's crew, the deck passengers, and even merchandise known as "deck loads."

The Suez Canal Co. recognizes in the meantime that a space may be considered as open, and consequently excluded from tonnage, if there is an opening not provided with means of closing, the breadth of which is equal to or greater than half the breadth of the deck opposite the opening, and if the space can not be used to shelter other merchandise than deck cargo.

In order to make this last restriction exact, the company recognizes that the space between the open face and a line drawn parallel to this face at a distance equal to half the width of the deck opposite the opening can not be used to shelter merchandise other than deck cargo, and that the remainder of the space may be used to shelter merchandise other than deck cargo and is not to be considered as open.

On the other hand, if, in the interior of the superstructure, because of any arrangement whatever and at a distance from the open face less than one-half the width of the deck, the opening becomes less than one-half the width of the deck (above indicated), only that portion of the space comprised between the open face and this point is to be considered as belonging to the second category; the remainder of the space falls within the third category.

Furthermore, in order that a space may be considered as open beyond a distance equal to one-half the width of the deck it is necessary that it be actually isolated from the other superstructures. This condition is not to be considered as fulfilled unless the space is separated from the superstructure immediately adjacent by a break (interval) in the roof and in the walls equal to at least half the width of the deck; if the widths of the deck opposite the openings of two adjoining superstructures are different, the smaller width is to be taken.

Third category: Spaces or portions of spaces open according to the national measurement rules, but which are closed-in according to the Suez rules, because they do not fulfill the conditions defined above for the second category.

It is to these spaces that the Rules of 1904 are applicable.

C. Nature of the Exemptions Permitted by the Rules of 1904.

The Rules of 1904 define the portions of the spaces comprised in the third category that may be exempted.

In these definitions the length of the ship indicated is the total length comprised between the interior face of the stem and the interior face of the rear sternpost, the measurement being taken at the half height of the superstructures.

It is, moreover, to be understood, in everything that follows, that in no case shall the exemptions include closed-in spaces or portions of closed-in spaces situated within exemptable parts.

I. Ships with one tier of superstructures.

1. *Isolated spaces.*

The exemptions permitted are as follows:

(*a*) *Poop.*—The portion of this space situated at the stern equal in length to one-tenth of the length of the ship measured from the interior face of the rear sternpost and at half the height of the poop. (Figs. 1 to 4.)[1]

(*b*) *Bridge.*—The portion of this space situated in way of the air spaces above the engine room and the boilers, it being understood that such air spaces are not considered to extend beyond the forward bulkhead of the stokehold or the after bulkhead of the main engine room. (Figs. 5 to 8.)

When the air spaces above the engine room and boilers are separated by an interval, the portion of the bridge in way of this interval is exempted. (Figs. 7 and 8.)

The exemption of the portions of the bridge in way of air spaces has the effect of excluding the volume of these air spaces from the tonnage of the ship and therefore from the measurement of the engine room.

[1] See plates at end of this appendix.

(*c*) *Forecastle.*—The portion of this space situated at the prow equal in length to one-eighth the length of the ship as measured from the interior face of the stem at half height of the forecastle. (Figs. 9 to 12.)

(*d*) In each of these three types of superstructures, the parts situated exactly opposite the openings not provided with means of closing and corresponding to each other in the walls of the ship. (Figs. 4, 8, and 11.)

2. *Combined spaces.*

(*a*) *Extended poop.*—The extended poop is subject to exemption in the same way as a bridge (portion in way of air funnels), but is not subject to the exemption of one-tenth as is an ordinary poop. (Fig. 13.) The forecastle, separated from the extended poop, is granted the exemption of one-eighth.

It sometimes happens that, in ships with isolated spaces, the air funnels of the engine, instead of being situated in the bridge, are located in the poop. In this case the poop is treated the same as an extended poop and is in consequence measured; the bridge alone benefits from the exemption permitted in paragraph 1*d* above (parts opposite the openings in the walls of the ship). The forecastle is granted the exemption of one-eighth. (Fig. 14.)

(*b*) *Extended forecastle.*—The extended forecastle is granted the exemption accorded to a bridge (portion situated in way of air funnels), but it is not granted the exemption of one-eighth as in case of an ordinary forecastle. (Fig. 13.) The poop, isolated from the extended forecastle, is granted the exemption of one-tenth.

(*c*) In every combined space the portions situated exactly opposite openings not provided with means of closing and corresponding to each other in the sides of the ship are exempted. (Figs. 13 and 14.)

3. *Shelter deck.*

In the case of shelter decks, the following exemptions are allowed: The portions situated exactly opposite openings in the side plating of the ship not provided with means of closing and corresponding to each other in the opposite walls of the ship are exempted. (Figs. 15 and 16.)

The air spaces situated within a shelter deck should be measured with the remainder of the volume of the engine room and deducted with the 75 per cent increment. (Figs. 15 and 16.)

II. SHIPS WITH MORE THAN ONE TIER OF SUPERSTRUCTURES.

(*a*) The lower tier alone is granted all the exemptions provided for in paragraphs 1, 2, and 3 above, for ships with a single tier of superstructures. (Figs. 17 and 18.)

In order that the air spaces above the engine and boilers existing in the lower tier of spaces defined in paragraphs 1 and 2 above (isolated spaces and combined spaces) may be comprised in the volume of space occupied by the machinery and then deducted with the 75 per cent increment (Fig. 19), the shipowner must forego the exemption of the space situated in way of air spaces (see above *b*, p. 174) and forego the exemption of open parts which may exist in the extremities of the space (see above, second category, pp. 415 and 416), as well as the exemption of parts situated opposite openings corresponding to each other in the walls of the ship. (See above, 1*d* and 2*c*.)

(*b*) The upper tiers may not benefit by the exemption of portions situated exactly opposite openings not provided with means of closing and corresponding to each other in the walls of the ship. (Figs. 17 and 18.)

The air spaces above the engine and boiler located in an upper tier may not be included in the volume of the engine and then be deducted with the 75 per cent increment (Fig. 19), unless the shipowner foregoes the exemption of open parts which may exist in the extremities of the space (see above, second category, pp. 415 and 416), and unless all the tiers below the tier under consideration are themselves measured the same as between decks.

(*c*) All the rules other than those which the company recognizes as in any category appertaining to a deck space (see above, pp. 415 and 416) are equally applicable to all the tiers.

D. Conditions for the Application of Exemptions Provided for by the Rules of 1904.

In order that the exemptions permitted may apply, there must be neither merchandise nor supplies of any kind in the portions of spaces which are entitled to benefit by exemption.

If a ship, but a single time, during her transit carries any merchandise of whatever nature, or coal for bunker purposes, or supplies in whatever amount, in any part of an exempted space, the entire space is added to the net tonnage and may never again be exempted.

E. Explanatory Sketches.

The sketches below illustrate the treatment applicable to deck spaces in some characteristic cases.

The spaces or portions of spaces of the first category are drawn in red; they are designated by the letter F.

The spaces or portions of spaces of the second category are indicated in white; they are designated by the letter C.

The spaces or portions of spaces of the third category are drawn:

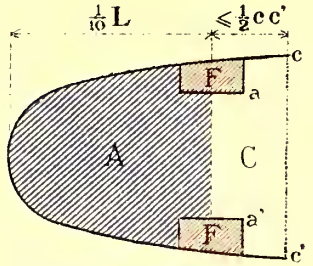
1. In blue, when they are exempted; they are then designated by the letters:
   A, for the poop and forecastle.
   M (air funnels of engines) and *m* (in way of air funnels), for the bridge.
   O, for the openings in the walls.
2. In brown[1] hatchings whenever they are measured; they are in this case designated by the letter B.

[1] In the original, French, edition of this memorandum, the spaces here shown in brown hatchings were shown by red and black hatchings.

1° Espaces isolés

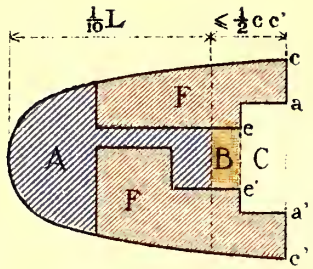
a. — *Dunette* (poop)

Fig. 1



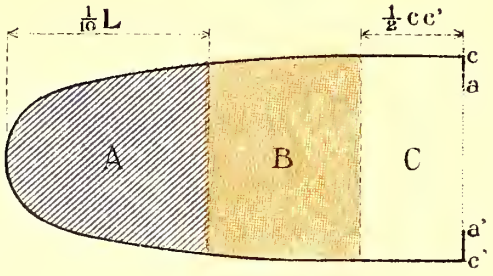
aa' $\geqslant \frac{1}{2}$ cc' et non muni de dispositifs de fermeture.

Fig. 2



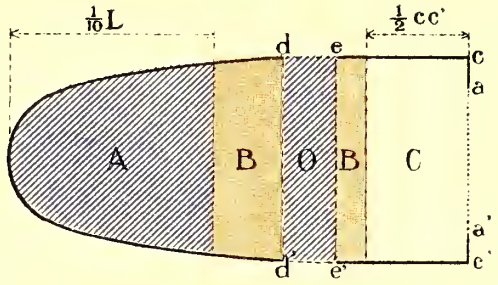
aa' $\geqslant \frac{1}{2}$ cc' et non muni de dispositifs de fermeture.
ee' $< \frac{1}{2}$ cc'

Fig. 3



aa' $\geqslant \frac{1}{2}$ cc' et non muni de dispositifs de fermeture.

Fig. 4



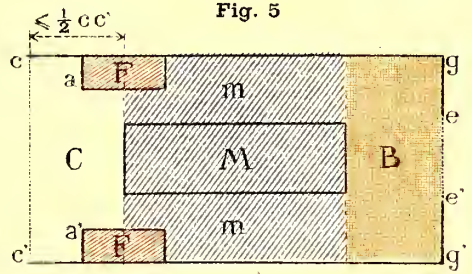
aa' $\geqslant \frac{1}{2}$ cc' et non muni de dispositifs de fermeture.
de } Ouvertures latérales non munies de dispositifs de fermeture
d'e' } et se correspondant dans les murailles.

N. B. — Dans les figures 1, 2, 3 et 4, il est supposé que la face antérieure de la dunette est séparée de la superstructure immédiatement voisine par un intervalle, dans le toit et dans les murailles, au moins égal à la $\frac{1}{2}$ largeur de pont.

1° Espaces isolés

b. — *Château central* (bridge).

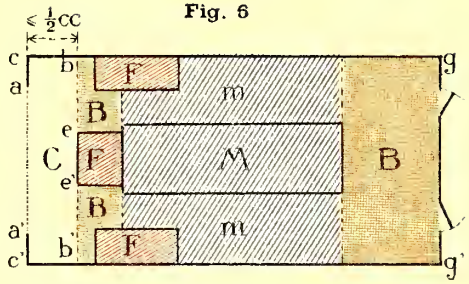
Fig. 5



aa' $\geqslant \frac{1}{2}$ **cc'** et non muni de dispositifs de fermeture.

ee' $< \frac{1}{2}$ **gg'**

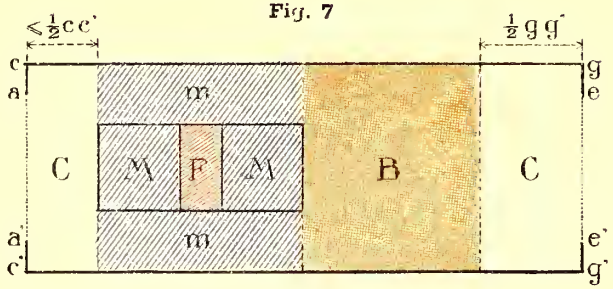
Fig. 6



aa' $\geqslant \frac{1}{2}$ **cc'** et non muni de dispositifs de fermeture.

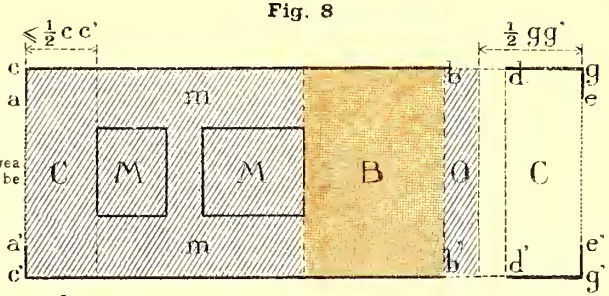
be $< \frac{1}{2}$ **cc'** **e'b'** $< \frac{1}{2}$ **cc'** **gg'** cloison avec portes.

Fig. 7



aa' $\geqslant \frac{1}{2}$ **cc'**
ee' $\geqslant \frac{1}{2}$ **gg'** } et non muni de dispositifs de fermeture.

Fig. 8



aa' $\geqslant \frac{1}{2}$ **cc'**
ee' $\geqslant \frac{1}{2}$ **gg'** } et non muni de dispositifs de fermeture.

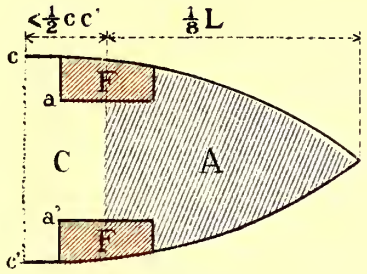
bd
b'd' } Ouvertures latérales non munies de dispositifs de fermeture et se correspondant dans les murailles.

N. B. — Dans les figures 5, 6, 7 et 8, il est supposé que la face postérieure du château central est séparée de la superstructure immédiatement voisine par un intervalle, dans le toit et dans les murailles, au moins égal à la $\frac{1}{2}$ *largeur de pont. Même supposition est faite, dans les figures 7 et 8 pour la face antérieure du château central. Enfin* **cc'** *et* **gg'** *doivent être les largeurs totales du pont.*

1° Espaces isolés

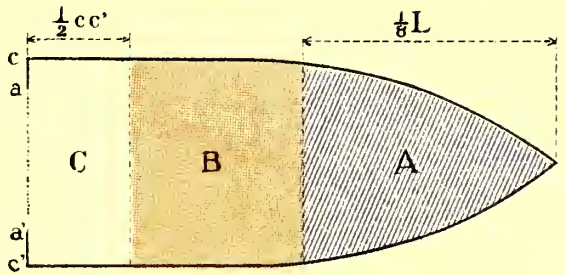
c. — *Gaillard d'avant* (forecastle).

Fig. 9



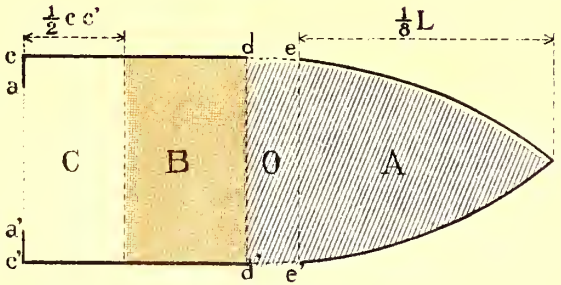
aa' ⩾ ½ **cc'** et non muni de dispositifs de fermeture.

Fig. 10



aa' ⩾ ½ **cc'** et non muni de dispositifs de fermeture.

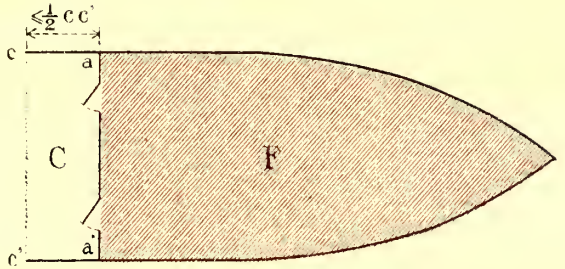
Fig. 11



aa' ⩾ ½ **cc'** et non muni de dispositifs de fermeture.

de } Ouvertures latérales non munies de dispositifs de fermeture
d'e' } et se correspondant dans les murailles.

Fig. 12



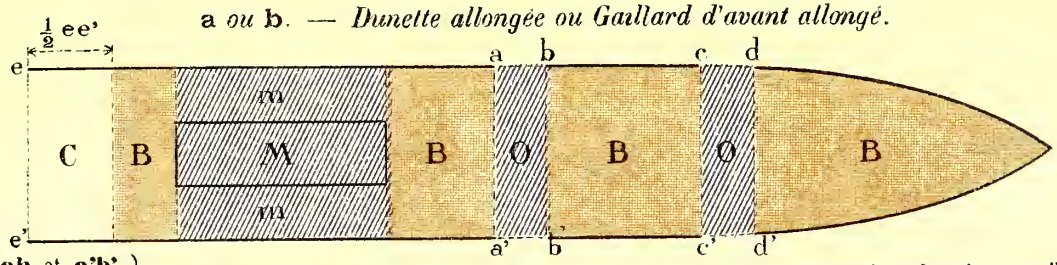
aa' Cloison avec portes.

N. B. — Dans les figures 9, 10, 11 et 12, il est supposé que la face postérieure du gaillard d'avant est séparée de la superstructure immédiatement voisine par un intervalle, dans le toit et dans les murailles, au moins égal à la ½ *largeur de pont.*

2° Espaces combinés

Fig. 13

a *ou* **b**. — *Dunette allongée ou Gaillard d'avant allongé.*

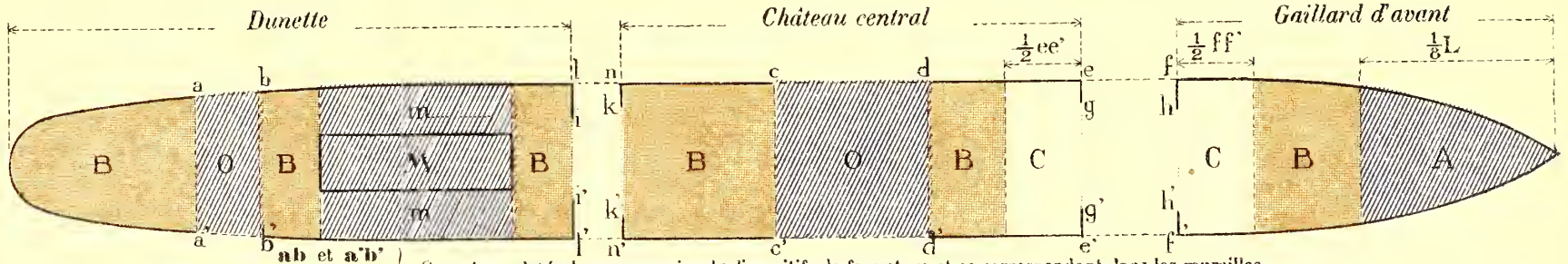


ab et **a'b'** } Ouvertures latérales non munies de dispositifs de fermeture et se correspondant dans les murailles.
cd et **c'd'** }

N. B. — Dans la figure 13, il est supposé que la face postérieure du gaillard d'avant allongé est séparée de la superstructure immédiatement voisine par un intervalle, dans le toit et dans les murailles, au moins égal à la $\frac{1}{2}$ *largeur de pont.*

Fig. 14

a. — *Dunette abritant les aérations de la machine et de la chaufferie.*



ab et **a'b'** } Ouvertures latérales non munies de dispositifs de fermeture et se correspondant dans les murailles.
cd et **c'd'** }

gg' et **hh'** Ouvertures transversales non munies de dispositifs de fermeture et $\geqslant \frac{1}{2}$ largeur du pont correspondante.

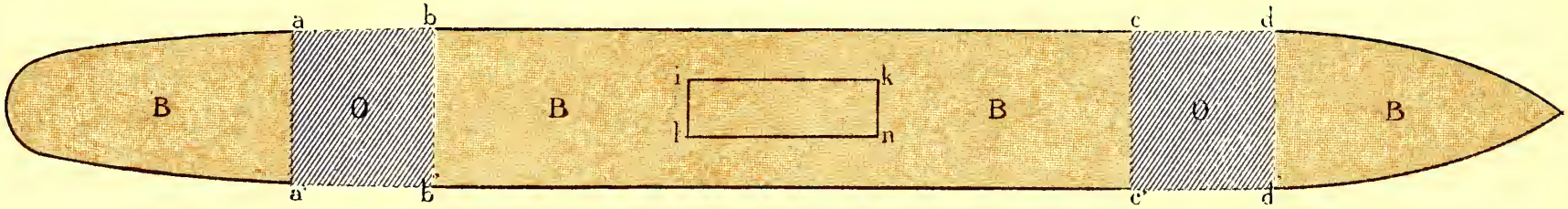
efe'f' Interruption dans le toit et dans les murailles $\geqslant \frac{1}{2}$ de la plus petite largeur du pont aux extrémités de la coupure.

ii' et **kk'** Ouvertures transversales d'une largeur quelconque et munies ou non munies de dispositifs de fermeture.

lnl'n' Interruption dans le toit et dans les murailles $< \frac{1}{2}$ de la plus petite largeur du pont au droit de **l** ou **n**.

3° Shelter-Deck

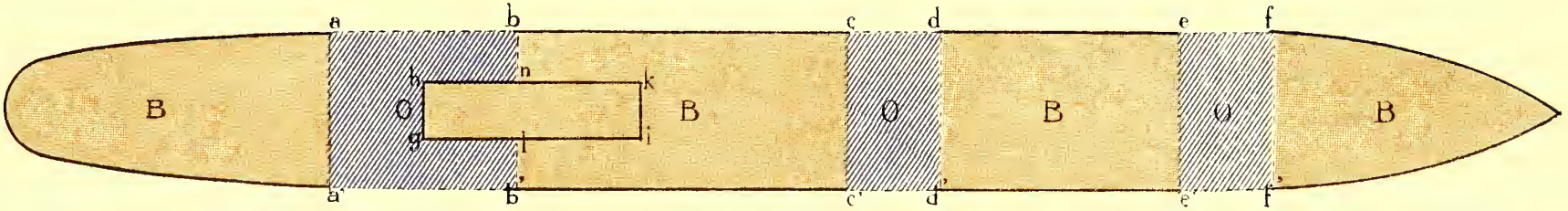
Fig. 15



ab et **a'b'**
cd et **c'd'** } Ouvertures latérales non munies de dispositifs de fermeture et se correspondant dans les murailles.

ikln Aérations de la machine et de la chaufferie à comprendre dans le volume de la machine et à déduire avec majoration de 75 %.

Fig. 16



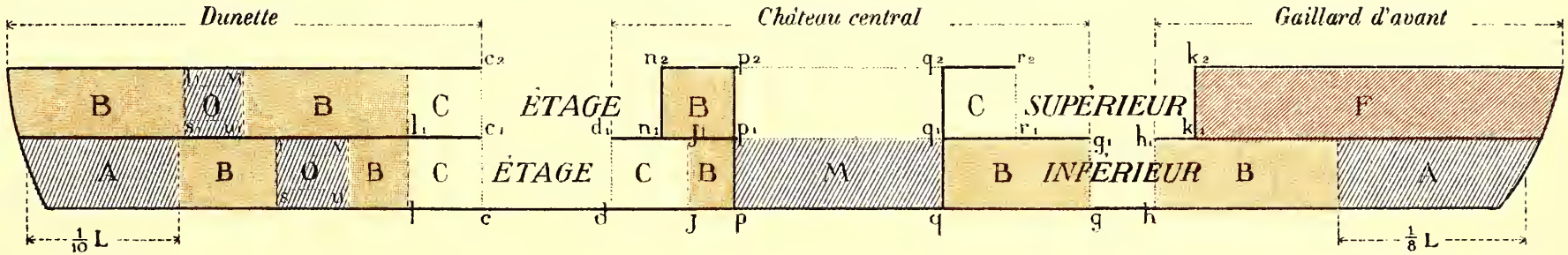
ab et **a'b'**
cd et **c'd'**
ef et **e'f'** } Ouvertures latérales non munies de dispositifs de fermeture et se correspondant dans les murailles.

ghikln Aérations de la machine et de la chaufferie à comprendre dans le volume de la machine et à déduire avec majoration de 75 %.

Fig. 17

Coupe longitudinale des superstructures

(Voir les coupes horizontales des superstructures à la figure 18.)



cc₁ et **dd₁** } Ouvertures transversales non munies de dispositifs de fermeture et $\geqslant \frac{1}{2}$ largeur du pont correspondante.
c₁c₂ et **r₁r₂** }

cc₁dd₁ et **r₁r₂k₁k₂** Interruptions dans le toit et dans les murailles $\geqslant \frac{1}{2}$ de la plus petite largeur du pont aux extrémités de la coupure.

gg₁ et **hh₁** Ouvertures transversales d'une largeur quelconque et munies ou non munies de dispositifs de fermeture.

gg₁hh₁ Interruption dans le toit et dans les murailles $< \frac{1}{2}$ de la plus petite largeur du pont au droit de **g** ou **h**.

lc $= \frac{1}{2}$ largeur du pont en **c**.

dj $= \frac{1}{2}$ largeur du pont en **d**.

l₁c₁ $= \frac{1}{2}$ largeur du pont en **c₁**.

q₁r₁ $\leqslant \frac{1}{2}$ largeur du pont en **r₁**.

n₁n₂ et **k₁k₂** Cloisons avec portes.

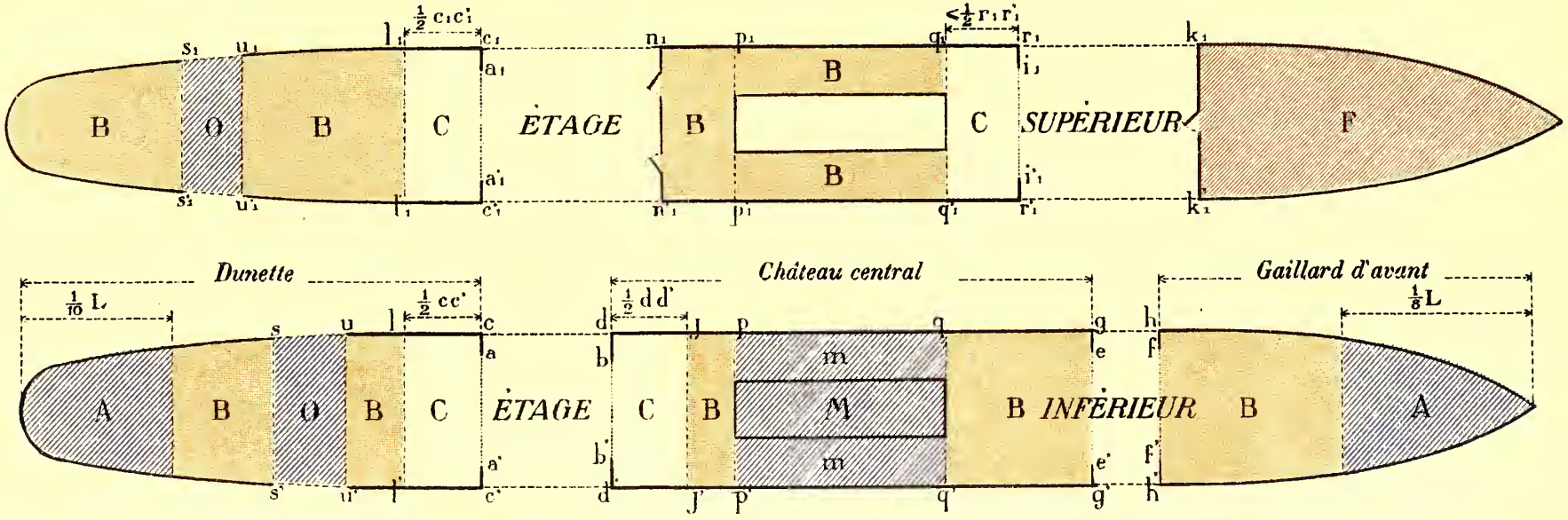
stuv
s₁t₁u₁v₁ } Ouvertures latérales non munies de dispositifs de fermeture et correspondant à une ouverture semblable dans la muraille opposée.

p₁p₂q₁q₂ Les aérations des machines et de la chaufferie existant dans cet espace ne sont pas comprises dans le tonnage brut, mais on mesure les parties de l'espace situées par leur travers.

Fig. 18

Coupes horizontales des superstructures

(Voir la coupe longitudinale des superstructures à la figure 17.)



aa' et **bb'**
$a_1a'_1$ et **$i_1i'_1$** } Ouvertures transversales non munies de dispositifs de fermeture $\geqslant \frac{1}{2}$ largeur de pont correspondante.

cde'd'
$c_1n_1c'_1n'_1$
$r_1k_1r'_1k'_1$ } Interruptions dans le toit et dans les murailles $\geqslant \frac{1}{2}$ de la plus petite des deux largeurs de pont correspondantes.

ee' et **ff'** Ouvertures transversales d'une largeur quelconque et munies ou non munies de dispositifs de fermeture.

ghg'h' Interruption dans le toit et dans les murailles $< \frac{1}{2}$ de la plus petite des deux largeurs de pont correspondantes.

$n_1n'_1$ et **$k_1k'_1$** Cloisons avec portes

su et **s'u'**
s_1u_1 et **$s'_1u'_1$** } Ouvertures latérales non munies de dispositifs de fermeture et se correspondant dans les murailles.

$p_1q_1p'_1q'_1$ Les aérations de la chambre des machines et de la chaufferie existant dans cet espace ne sont pas comprises dans le tonnage brut; mais on mesure les autres parties de l'espace situées par le travers de ces aérations.

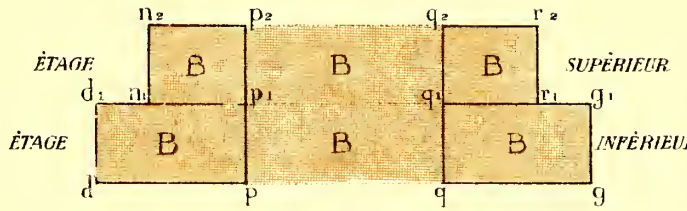
Fig. 19

Cas où, dans chaque étage, à la demande des armateurs, la superstructure est mesurée comme un entrepont, aérations comprises.

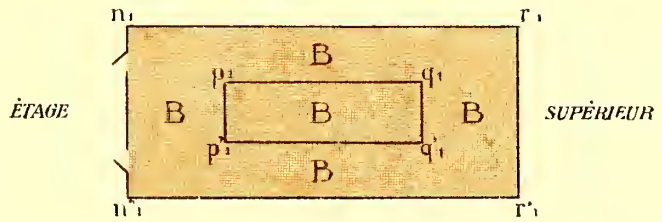
Légende des coupes

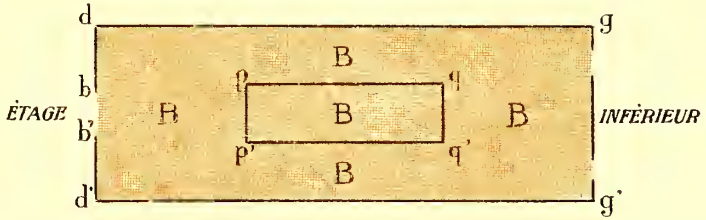
En plan	En élévation	
dd'	**dd₁**	Cloisons avec ou sans portes
gg'	**gg₁**	
n₁n'₁	**n₁n₂**	
r₁r'₁	**r₁r₂**	
dd'		Largeur totale du pont
n₁n'₁		
pq p'q'	**pq p₁q₁**	Aérations de la machine et de la chaufferie.
p₁q₁p'₁q'₁	**p₁q₁p₂q₂**	

Coupe longitudinale



Coupes horizontales





Conditions d'application

ÉTAGE SUPÉRIEUR

Les aérations existant dans l'étage supérieur ne peuvent être comprises dans le volume de la machine, pour être déduites avec majoration de 75 %, que si l'étage inférieur est lui-même mesuré comme un entrepont.

ÉTAGE INFÉRIEUR

L'armateur renonce à l'exemption des parties latérales des aérations de la machine et de la chaufferie.

N. B. — Dans la figure ci-contre **bb'** est $< \frac{1}{2}$ **dd'**. Si, au contraire, **bb'** était $\geqslant \frac{1}{2}$ **dd'** (voir fig. 18), l'armateur devrait, pour bénéficier, aux deux étages, des déductions des aérations avec majoration de 75 %, renoncer, en outre, à l'exemption de la partie ouverte s'étendant à partir de **bb'** sur $\frac{1}{2}$ largeur du pont.

APPENDIX XIV.

BRITISH BOARD OF TRADE INSTRUCTIONS TO SURVEYORS CONCERNING THE MEASUREMENT OF VESSELS FOR THE ISSUE OF SUEZ CANAL CERTIFICATES, 1913.

APPENDIX XIV.

BRITISH BOARD OF TRADE INSTRUCTIONS TO SURVEYORS CONCERNING THE MEASUREMENT OF VESSELS FOR THE ISSUE OF SUEZ CANAL CERTIFICATES.[1]

114. *General.*—The transit dues of the Suez Canal are charged on the basis of the net tonnage ascertained in accordance with the system of measurement recommended by the International Commission which assembled at Constantinople in 1873.

Extracts from the report of the commission,[2] including the regulations for tonnage measurement, are printed on pages 385 to 390 and 407 to 412, and in accordance with the recommendations of the commission, the Board of Trade are prepared to issue certificates (form surveys 60A) of the tonnage of vessels calculated in the manner prescribed by the rules in question.

115. When a shipowner wishes a ship to be measured for a special certificate under the rules applicable to the Suez Canal, application should be made on the form surveys 6, and the fee[3] should be paid to the superintendent of a mercantile marine office. In the case of unregistered structures of special types, e. g., floating docks, etc., the applicants should be referred to the London office of the Suez Canal Co.

116. The surveyor should, on receipt of the application, apply to the principal surveyor for tonnage in London for the formula and papers of the previous measurement of the ship.

GROSS TONNAGE.

117. *Under-deck measurement.*—For the purpose of the special certificate it will be the duty of the measuring surveyor to include in the gross measurement the entire cubic contents of the ship under the uppermost deck, except the space (if any) between the inner and outer plating (upon whatever system constructed) known as a double bottom for water ballast, which can be certified as not available for the carriage of cargo, stores, or fuel. The deep-water ballast tanks known as fore or after peak tanks are to be included in the tonnage measurement.

118. In the case of vessels which have already been measured for British tonnage, it will not be necessary to remeasure the tonnage under the uppermost deck, unless the Surveyor finds that some space has formerly been exempted that must, under the Suez Canal Rules, be included, or vice versa, or unless the British under-deck tonnage is measured under the modified rule set out on pages 276 to 278.

119. *Spaces above deck.*—For the purpose of the special certificate the surveyor must also include in the gross tonnage the entire cubic contents of every covered and closed-in space above the uppermost deck, and with regard to such spaces he should be guided by paragraph 1 of the regulations, page 407, and by the instructions contained in the following 11 paragraphs (120 to 130) which relate only to spaces entitled to exemption from British tonnage measurement. It should be noted that spaces covered only by planks separated from one another by intervals exceeding 1 inch in breadth are not to be included in the gross tonnage.

120. *Open spaces.*—If the permanent opening measured at the end of the erection (forecastle, bridge space, or poop) is equal to or greater than one-half the breadth of the deck in way of it, and is not fitted with a coaming, the portion of the erection measured from the open end, and not exceeding in length such half breadth, is (subject to the following paragraph)

[1] The paragraph numbers are those in the Board of Trade's official publication. The numbers are retained to facilitate reference to the official document. The references in the text to paragraph numbers are to the numbers of the paragraphs reprinted in Appendix IV of this report.

[2] The report is printed as a Parliamentary Paper [C.—943], 1874.

[3] See par. 2, p. 283.

to be regarded as an "open space" and described as such on the back of the Suez Canal certificate. When, however, a coaming is fitted to such an opening the space within it is to be included in the gross tonnage in every case, and only the exemptions provided for in paragraphs 123 to 130 are to be allowed.

121. If in the interior of an erection, in consequence of any arrangement whatever, and at a distance from the open end less than half the breadth of the deck as above defined, the opening is at this point less than the said half breadth, only the length of the space between that point and the open end of the erection is to be regarded as an "open space" and described as such on the back of the Suez Canal certificate.

122. The above instructions respecting "open spaces" apply to deck erections extending from side to side, whether situated in the lowest or any other tier, but in all cases where the openings in these erections are less than the half breadth of the deck in way of them they are to be measured in the gross tonnage and only the exemptions provided for in paragraphs 123 to 130 are to be allowed. When, however, two side-to-side erections are separated by an interval, the length of which is less than the least half breadth of the deck in way of such interval, then, whatever be the breadth of the permanent openings, the erections less the interval are to be measured in the gross tonnage, and only the exemptions provided for in paragraphs 123 to 130 are to be allowed.

123. *Exempted spaces.*[1]—In the case of shelter-deck spaces with one or more openings in the shelter deck and sides of the vessel the whole of the space under the shelter deck should be included in the tonnage measurement with the exception of that part of the space which is immediately abreast the openings (if any) in the sides of the ship.

124. In all cases where a vessel is fitted with forecastle, bridge space and poop, there shall be exempted from measurement (*a*) such length of the forecastle, measured from the inside of the stem at half height of the said forecastle, as shall be equal to one-eighth of the full length of the ship; (*b*) such length of the poop measured from the inside of the stern timber at half height of the said poop as shall be equal to one-tenth of the full length of the ship; (*c*) such length of the bridge as is equal to the length of the actual deck openings to engine and boiler spaces, it being understood that such openings shall not be considered to extend beyond the forward bulkhead of the stokehold and the after bulkhead of the main engine room.

125. In all cases where the poop and bridge, or forecastle and bridge, are combined and continuous, then only that length in each case which is due to the openings of engine and boiler spaces as defined under 124 (*c*) above shall be exempted from measurement.

126. From the side-to-side erections referred to in the foregoing paragraphs 124 and 125 further exemptions may also be allowed for the portions of the spaces abreast of the permanent openings (if any) in the side plating, and also for the "open spaces" referred to in paragraphs 120–122 above.

127. When the engines are aft and the light and air casings are situated in an ordinary poop, the space is to be dealt with as for a combined poop and bridge, but the bridge space is to benefit only by the exemption of the portion abreast the permanent openings (if any) in the side plating or "open spaces" at the ends.

128. By "full length of the ship" shall be understood, in all cases, such length as is comprised between the inside of stem at half height of the forecastle to the inside of the stern timber at half height of the poop.

129. The exemptions provided for in paragraphs 124 and 125 above apply, in their entirety, only to deck erections situated in the lowest tier; the only exemptions to be made in side-to-side erections situated above this tier, and besides the "open spaces" (if any), are those portions immediately abreast of any permanent openings which may exist in the side plating.

130. In the case of shelter-deck spaces, the exemptions provided for may be allowed on the written request of the owners, either in the shelter-deck space as provided for in paragraph

[1] These exemptions were agreed on between the Board of Trade and the Suez Canal Co. in 1904 and were embodied in what were known as "the 1904 rules."

123 above, or in the erections on the shelter deck as provided for in paragraphs 124 and 125, but in no case are exemptions to be allowed under paragraph 123 in addition to exemptions under paragraphs 124 and 125.

131. *Light and air casings over engines and boilers.*—The engine and boiler casings in the shelter-deck spaces are to be included in the gross tonnage and in the engine-room measurement, even if situated in part within an otherwise exempted space abreast permanent side openings.

132. In the case of side-to-side erections above the lowest tier the light and air casings may be included in the gross tonnage and actual engine room provided the owner makes a written application for same, and also on condition that the side-to-side spaces beneath it have been similarly treated. When, however, the spaces are so dealt with no exemption is to be made from such spaces for any other portion whatever, either in the tier in question or in those beneath it.

133. Subject to the foregoing the light and air casings in all erections above the first tier are to be exempted from measurement.

134. *Full particulars to be sent to principal surveyor.*—In every case the surveyors when sending the formula and form surveys 60A to the principal surveyor for tonnage for examination should also forward a scale plan of the deck spaces showing the dimensions of the "open spaces," the position and width of the openings in the bulkheads and sides, and the termination of the deck or covering of the space, as well as all other necessary particulars. If a plan is unobtainable the particulars should be inserted on form surveys 131, 131A, 131B, or 131C as the case may require. The dimensions and tonnage of the exempted spaces should be shown in the columns provided for the purpose in the form surveys 60A.

135. *Marking of exempted spaces.*—All exempted spaces must be permanently and conspicuously marked by a plate securely fixed to each side of the vessel to indicate the limits and length allowed, corresponding with the particulars shown upon the back of the Suez Canal certificate; the center of such plates should be marked thus * and the inscription upon them should be as follows:

"This space,_____feet in length from the inside of the { stem / or / stern timber } at the half height of the space to this mark is exempted from Suez Canal tonnage upon the ground that no cargo or stores are carried therein."

136. *Access.*—The surveyors must see that some satisfactory means are provided either by manhole or hatchway for gaining access to the exempted parts, in the event of the parts adjacent being filled with cargo. It would be well in all cases for the manhole or other opening to terminate at the point to which the exempted space extends.

137. The regulations of the Suez Canal Co. provide that if at any time a vessel shall perform transit with cargo or stores carried in any portion of any exempted space, then the whole of that space shall be added to the net tonnage, and can only be again exempted from measurement after a bona-fide change in the ownership of the vessel.

NET TONNAGE.

138. *Allowance for propelling power.*—Having ascertained the gross tonnage in the manner described above, the measuring surveyor will then proceed to measure the engine room, boiler space, and shaft trunk as for a certificate of British registry, and note in the proper place in the survey form and on the certificate the cubic contents of each.

139. In cases where the owners elect not to use the "Danube rule" (see p. 387), but to have the actual bunker space as well as the actual engine space measured and deducted, the surveyor will measure separately the bunkers, and record the cubic capacity of each in the proper place in the form. In doing this he is not to include any bunkers that are not absolutely permanent, or from which the coals can not be directly trimmed into the engine room or stoke-

hold, or into which any access can be obtained otherwise than through the ordinary coal shoots on deck and from the doors opening into the engine room or stokehold. He is to be specially careful that thwartship bunkers which can be in any way extended are not included in the measurements for deductions.

140. In no case, except in the case of tugs, is the engine-room allowance to exceed 50 per cent of the gross tonnage of the ship.

141. *Crew-space deductions.*—In measuring the deductions for crew space the surveyor will be careful to ascertain the cubic contents of each space as at present, but he must bear in mind that no deduction is to be made for the accommodation of the captain, purser, clerk, etc., or for the berths of stewards, cooks, in passenger steamers, or passengers' servants. Passages exclusively for access to deducted crew spaces may themselves be included in the deductions.

142. The following special deductions in respect of accommodation spaces are allowed:

(*a*) Doctors' cabins, if actually occupied by the doctors.

(*b*) All spaces fitted as bathrooms, or lavatories, for the exclusive use of the ship's officers, engineers, and crew, with the exception of such of the said bathrooms as are available for passengers when no bathroom for their exclusive use is provided.

(*c*) A mess room, if there is any, for the exclusive use of the officers; a second mess room, if there is any, for the exclusive use of the engineers; and a third mess room, if there is any, for the exclusive use of the petty officers.

No deduction is allowed for the officers' mess room in ships having passenger accommodation, which are not also provided with a passengers' mess room.

143. No deduction is to be allowed for crew space or for officers' cabins, unless the regulations as to lighting, sea worthiness, and ventilation are complied with, nor unless the words "certified to accommodate ——— seamen," "certified to accommodate ——— officer or ——— officers," as the case may be, are cut in or painted on or over the doorway of each deducted space.

144. All water-closets having been included in the first place in the gross tonnage, those that are to be included in the deduction from tonnage are to have the words "certified for the use of ——— crew" cut in or painted on or over the door.

145. In the case of passenger steamers on which there is only one galley, neither the galley nor the space occupied by the cook should be included in the deductions from the gross tonnage.

When there are two or more galleys, however, the space occupied by the galley or galleys exclusively used for the crew should be included in the deductions, and the words "certified for the use of the crew" should be cut in or painted on or over each doorway of the space.

146. *Navigation-space deductions.*—Articles 12 and 14 of the regulations (p. 410) allow the deduction of any covered and closed-in spaces on the upper deck used for working the helm, the capstan, the anchor gear, and for keeping the charts, signals, and other instruments of navigation. Under this rule the wheel house, chart room, winch house, lookout house, signal house, steam-steering house, and the spaces provided for the storage of electric searchlights and wireless-telegraphy appliances on the upper deck are to be deducted from the gross tonnage, in which, however, they are in every case first to be included.

147. The chart room may be deducted, even if it is also used as the captain's cabin. When, however, the captain's accommodation comprises several rooms, one of which is the chart room, that room alone is deducted; but in all cases the room used as a chart room must, if it is to be deducted, be situated on the upper deck.

148. When the donkey boiler in a closed-in space on the upper deck is not exclusively used for the working of the helm, the capstan, and anchor gear, or any of them, but is also available for hoisting the cargo, the space is not to be included in the deductions from the gross tonnage.

This instruction does not apply to the donkey boiler house on the upper deck of men-of-war and troop ships.

149. *Marking of deducted spaces.*—In granting deduction for the chart house, winch house, and wheel house, or any other covered and closed-in space on the uppermost deck used for navigating the ship, the surveyor must see that the words "certified for use in navigating the ship" are cut in or painted on or over the doorway of the space, and in like manner all spaces deducted from the gross tonnage are to have cut over them or painted on them a notice stating the purpose for which they are certified.

150. *General.*—In no case is any space to be deducted from the tonnage that is not first included in the gross tonnage, and in no case is the sum total of the deductions (other than the allowance for propelling power) to exceed 5 per cent of the gross tonnage of the ship.

151. No deduction is to be made for passenger accommodation, captains' or passengers' water-closets or lavatories, etc., passengers' cooking houses, or luggage storerooms, or for any other purpose than those indicated above.

152. It may happen that there are in certain ships some awnings or other constructions used merely for shelter (see p. 407), the space under which is not to be included in the gross tonnage, and is therefore not to be deducted afterwards. When this is so the surveyor should make a careful note of the particulars in the proper place in the forms.

153. When the surveyor is in any doubt whether any space should be exempted or deducted he should apply for instructions to the principal surveyor for tonnage.

154. A formula and certificate showing the dimensions and computations are to be sent to the principal surveyor for tonnage for the purpose of test and examination a few days before the vessel is expected to sail, so that any question which may arise regarding the spaces shown therein may be dealt with before the vessel leaves the port of survey.

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APPENDIX XV.

INSTRUCTIONS OF THE GERMAN GOVERNMENT FOR THE APPLICATION OF THE SUEZ RULES TO THE MEASUREMENT OF VESSELS.

APPENDIX XV.

INSTRUCTIONS OF THE GERMAN GOVERNMENT FOR THE APPLICATION OF THE SUEZ RULES TO THE MEASUREMENT OF VESSELS.

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INSTRUCTIONS FOR MEASUREMENT OF VESSELS FOR PASSAGE THROUGH SUEZ CANAL.

SECTION 1. Vessels destined for passage through the Suez Canal may be measured at the request of owners or masters, according to the following requirements:

SEC. 2. The ascertaining of the gross tonnage is governed by sections 4 to 12 of the ship-measurement ordinance.

I. In the measurement for gross tonnage the following spaces will be included:

(*a*) The tonnage of all covered and closed-in spaces, or spaces arranged so that they may be closed, in the permanent superstructures on or above the upper deck that are closed in with roofing and permanent bulkheads, so that they may serve as spaces for storing cargo or provide shelter and other comfort for passengers or crew, including the captain (excluding the exceptions that are permitted under the provisions of Par. II below).

(*b*) The tonnage of all decked and closed spaces, or spaces arranged so that they may be closed, in permanent superstructures on or above the upper deck intended for navigation and service of the vessel.

(*c*) The tonnage of all spaces intended for the admission of light and air to the engine room or for the actual efficiency of the engines, when these spaces are in superstructures that may be closed in, and which extend from side to side entirely across the ship. This type of superstructure must not be treated according to No. II below.

(*d*) The tonnage of all hatches and hatch covers up to one-half of one per cent of the gross tonnage.

II. From gross tonnage the following spaces will be exempted:

(*a*) In vessels with forecastle, bridge house, and poop—

(1) That part of the forecastle measured at half height from the rear surface of the prow post equal in length to one-eighth of ship's length.

(2) That part of the poop measured at half height from the front surface of the center stern timber equal in length to one-tenth of the ship's length. The ship's length will be reckoned from the rear face of the prow post at half height of the quarter deck to the front face of the center stern timber at half height of the poop.

(3) That part of the bridge house in way of the deck openings to engine and boiler space (under restrictions of I*c*).

For the purpose of fixing the limits of this excluded part only those deck openings are considered which do not extend over the front bulkhead of the boiler room and the rear bulkhead of the main engine room.

(*b*) In vessels with a combination poop and bridge or a combination quarter deck and bridge, the space in way of the deck openings to engine and boiler room as given under (*a*) for bridge houses.

The above spaces exempted from measurement must be given singly, not only by name, and entered in the measurement certificate with measurements and tonnage. If a vessel at any time during the passage through the Suez Canal carries cargo or stores in any part of these spaces, the whole space in question will be included in the net tonnage and will not again be exempted from measurement.

III. The following spaces are always exempted from gross tonnage:

All shelter-deck spaces not inclosed and permanently arranged for shelter during stress of weather or sea, but joined to the vessel merely by stanchions, even when these spaces are used for protection of the crew and deck passengers or afford shelter for the deck cargo.

SEC. 3. To determine net tonnage, the following spaces are deducted from gross tonnage:

I. The tonnage of those covered and closed-in spaces in permanent superstructures on the upper deck, used for the service of the rudder, capstan, and anchor, also those for protection of the charts, signal apparatus, and other nautical instruments, as well as the spaces for use of the crew (art. 14 A–1 of the ship measurement ordinance); not, however, the space for the captain (art. 14 A–2, same), under the following conditions:

(1) Every space, for which such a deduction has been made, must be provided in a conpicuous place with a notice showing for what purpose such a space is exclusively used. The kind of notice is fixed by the Bureau of Registry. Spaces not so posted can not be included in the deductions.

(2) Every deduction is canceled as soon as one of the posted spaces entitled to deduction is used for the reception of stores or freight, or for shelter or other comfort of passengers.

(3) In other respects the following rules pertaining to deductions from gross tonnage will govern:

(*a*) Deductions will be made for a surgeon's cabin only when there is a surgeon on board.

(*b*) The following may also be deducted:

A dining room, in case it is used exclusively for the ship's officers and engineers. The deduction, however, is not allowed on passenger vessels on which there is no dining room, especially for passengers.

A second dining room in case it is used exclusively by the boatswain, carpenter, etc.

(*c*) A space arranged for bathroom will be deducted, if there are no passengers on board and the bathroom is used exclusively by officers and engineers.

A space arranged for bathroom will be deducted, although passengers are on board, in case there are several permanent bathrooms on board the vessel. In this case one of the bathrooms provided will be considered for the use of officers and engineers.

(*d*) Stewards and cooks on passenger steamships, and passengers' servants are not regarded as members of the crew for whom deduction can be made.

(4) The total deduction per I may not exceed one-twentieth of the gross tonnage.

II. The tonnage of engine and boiler rooms and coal bunkers will be deducted either according to actual measurement or according to the Danube rule.

(1) The following will govern in case of deduction by actual measurement:

(*a*) The length of the engine room, as well as the permanent coal bunkers, will be measured between the limiting permanent bulkheads. Then according to requirement of article 7, ship measurement ordinance, three cross sections are measured to the height of the engine-room deck or the deck directly over the engine room; that is, a cross section at each of the two ends and a cross section in the middle of the length. To the sum of the end sections four times

the area of the middle section is added, and this sum is multiplied by one-third of the distance between the cross sections. The product represents the contents of the room.

(*b*) If the deck mentioned in (*a*) over the engine-room deck is not the upper deck of the vessel the tonnage of the space between the deck mentioned and the upper deck (if not connected with the engine or is not used for entrance of light and air) will be found by multiplying together the length, breadth, and depth taken at the middle. The contents of this space will then be added to the contents of the other engine-room spaces. The same rule holds with regard to the contents of the permanent coal bunkers and other fuel compartments, which extend through two or more decks.

(*c*) If the engines, boilers, or the fuel bunkers are in separate compartments they will be separately measured in the manner prescribed in (*a*) and (*b*).

(*d*) To ascertain the contents of the space taken up by the shaft tunnel or tunnels of screw steamers, the mean lengths, breadths, and depths of the tunnel are multiplied together. If the tunnel has several divisions, each must be measured separately.

For measurement of closed-in and covered spaces on or above the upper deck, intended for admission of light and air to the engine room or for the actual working of the engine, the instructions in article 12, ship measurement ordinance, will apply.

(2) In using the Danube rule the following method controls:

(*a*) The tonnage of engine and boiler rooms, exclusive of coal space, is measured as follows:

Measure the middle depth of the space between the under edge of the deck above the engine to the planking next to the keelson. At half height of the space three widths are measured, one at each end and one in the middle of the length. When necessary more than three widths are measured. The mean of the widths is then taken. The mean length of the space between the front and rear bulkheads is then taken, excluding, however, that part of the former which is not actually taken up by the engine and boilers or necessary to their working. The dimensions thus found, length, breadth, and depth, are multiplied together and the result is the cubical contents of the space under the deck above the engine room. If the deck mentioned is not the upper deck of the vessel, the volume of the space or spaces between the deck already measured and the upper deck (if not connected with the engine or used for the admission of light and air) are ascertained by taking the mean dimensions, length, breadth, and depth of each and multiplying them together. The total contents of these spaces will then be added to the other engine-room space. By upper deck in these instructions is meant the deck containing permanent superstructures capable of being closed in and extending from side to side across the entire breadth of the vessel. Spaces for admission of light and air, or for the actual working of the engine, are to be considered as properly to be deducted as part of the engine-room space only when they are under the upper deck (that is, the deck extending over the entire length and breadth of the vessel), or are contained in superstructures that may be closed in and which extend from side to side across the entire width of the vessel. If the engine and boilers are in separate compartments, the contents of each compartment will be ascertained according to the above rules and the sum of their contents taken as the contents of the entire space. In screw steamers the space occupied by the shaft-tunnel must be added to the engine-room space. The volume of this is obtained according to instructions in this paragraph under II 1d.

(*b*) The tonnage of coal bunkers is not measured, but in screw steamers is taken at 75 per cent and in paddle-wheel steamers at 50 per cent of the engine and boiler space, as found in (*a*).

(3) The total deduction for engine, boiler, and coal-bunker spaces must not exceed half of the gross tonnage of the ship, except in the case of steam tugs.

SEC. 4. The measurement certificate is made out according to article 24, paragraphs 3 and 4, of the ship measurement ordinance and the accompanying forms.[1]

SEC. 5. The fees for the application of the complete method and for making out the measurement certificate, including stamp costs, when the space under the tonnage deck does not require to be remeasured, are 2½ pfennigs, for each cubic meter or fraction of gross capacity of

[1] See Form 3, in Chapter IV, facing p. 54, for the English form of the Suez certificate. The German form is substantially similar.

the vessel. If under article 7, paragraph 2, a new measurement of the space under the tonnage deck is made 2½ pfennigs for each cubic meter or fraction of the space under the tonnage deck must be added to the fees mentioned. Partial measurements due to repairs or a change in utilization of space, including making out a new measurement certificate, and stamp dues, are charged at 2½ pfennigs for each cubic meter or fraction, whether the new calculation is based on actual measurement or on the acceptance of an earlier measurement. The minimum fees are 2 marks.

NOTE.—For making out additional measurement certificates without previous measurement the dues are 2 marks, according to notice of July 19, 1890, Zentral-Blatt, German Empire, page 281.

SEC. 6. The contents of the measurement certificate according to article 29 of the ship measurement ordinance must be recorded in the record indicated. All notes relating to the measurements and calculations made must be preserved in the manner there shown. When a measurement certificate is made out a copy must be sent to the bureau of registry.

SEC. 7. In other respects the principles and provisions of the ship measurement ordinance and the accompanying instructions will also apply.

The methods prescribed in the last paragraph of article 18 and in paragraphs 6 to 9 of article 21, Instructions for Ship Measurement, will, at the request of the owner, not be applied in the measurement for passage through the Suez Canal. In place thereof the general method given in article 6 and paragraphs 4 to 6 of article 7, ship measurement ordinance, will be used.

APPENDIX XVI.

COMPARATIVE ANALYSIS OF THE PROVISIONS APPLYING THE SUEZ RULES FOR THE MEASUREMENT OF VESSELS BY FRENCH, ENGLISH, AND GERMAN SURVEYORS.

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COMPARATIVE ANALYSIS OF THE PROVISIONS APPLYING THE SUEZ RULES FOR THE MEASUREMENT OF VESSELS BY FRENCH, ENGLISH, AND GERMAN SURVEYORS.[1]

I.—Method of Taking Measurements.

FRANCE.	ENGLAND.	GERMANY.

CALCULATION OF THE PRINCIPAL VOLUME.

FRANCE.

In France and in Germany the Constantinople rules are not strictly applied. For Suez tonnage the principal volume is measured in the same way as for the national tonnage; but the necessary correction is made to keep or to add th volume of peaks and tanks for water ballast that are not exempted by the (Constantinople) rules of 1873, but are exempted in the national tonnage rules.[2]

ENGLAND.

In England the Constantinople rules are strictly conformed to.

LENGTH.

The number of subdivisions of the length is given in the following table:

First. 15 meters, at least (50 feet)	= 4
Second. 15 to 37 meters (50 to 120 feet)	= 6
Third. 37 to 55 meters (120 to 180 feet)	= 8
Fourth. 55 to 69 meters (180 to 225 feet)	=10
Fifth. Longer than 69 meters (longer than 225 feet)	=12

In the case of vessels with irregular bottom lines the vessel is not divided into several segments to be considered separately.

DEPTH.

It is taken at each point of subdivision of the length from one-third the rise of the tonnage deck to the top of the

GERMANY.

As in France, the volume found in calculating the national tonnage is taken as a basis, the necessary corrections being applied thereto.

[1] Translated in 1911 by Lieut. C. Garlington, C. E., from "Etude sur le Juageage," by V. Beret. *Controleur-Adjoint de la Navigation de la Compagnie Universelle du Canal Maritime de Suez. Paris, 1905.*

[2] National rules of Germany now include all water-ballast tanks other than double bottoms in gross tonnage. In ascertaining net tonnage for German registry they are deducted if used solely for water ballast.

FRANCE.	ENGLAND.	GERMANY.
	keelson, deduction being made for the average thickness of the sheathing. In case there is a double bottom water-ballast space with convex or concave ceiling, no correction is made.	
	WIDTH.	
	To measure it, the height is divided into a certain number of equal parts: Four, if the middle section is less than 16 feet; six, if it is more than 16 feet. The width at each point of division is measured as for the national tonnage. In the case of lateral water-ballast tanks the widths are measured to the interior of the ribs. These water-ballast spaces are thus exempted only when they are less in thickness than the thickness of the ribs. In the case of refrigerator walls, 3 inches is allowed as the average thickness of the sheathing, as in the national tonnage rules.	

CALCULATION OF THE AREA OF CROSS SECTIONS.

This is carried out rigorously according to the provisions of the Constantinople rules:

		Except in Germany; and there also except in the case where the depth has been divided into one part in excess of what the Constantinople rules prescribe. (See Appendix 8.)
	A new case arose (May, 1905) which has received a special solution. As the figure indicates, the rib BAD was bent back into the interior of the vessel. Above and outside of the rib there was a water-ballast compartment.	

FRANCE.

ENGLAND.

The cross section was divided into three parts, which were considered separately: A′ADD′—B′BAA′—C′CBB′.

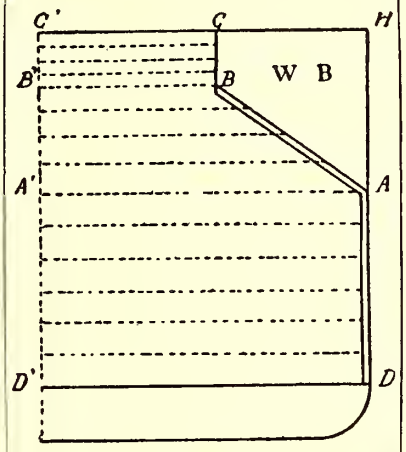


Fig. 1.

The lower part was measured to the interior face of the rib, the intermediate part to the interior face of the water-ballast tank, and the upper part likewise.

The water-ballast tank was thus exempted, and in the part BB′A′A the volume corresponding to the thickness of the rib was measured.

The Suez Co. approved this method proposed by the board of trade.

GERMANY.

BREAKS.

They are treated in the three countries as in the national tonnage rules. The line passing through a point one-third the rise of the tonnage deck above the chord joining the ends of the deck curve is prolonged, and the depths for the principal volume are measured from this imaginary line. The space in the break above this line is measured according to the formula for spaces limited by curved surfaces.

SPECIAL TYPES OF VESSELS.

The peculiarities of turret vessels are treated in the same manner for Suez tonnage as for national tonnage.

MEASUREMENT OF 'TWEEN DECKS.

In the three countries the volume of the 'tween decks is measured in the same manner as for national tonnage. (See Appendix 8.)

MEASUREMENT OF THE TURRET OF A TURRET SHIP.

The treatment applied to the turret of a turret ship is the same for Suez tonnage as for national tonnage. (See Appendix 8.)

MEASUREMENT OF SUPERSTRUCTURES.[1]

It is carried out everywhere in the same way as for national tonnage.

II.—*Exemptions.*

Spaces Exempted Below the Tonnage Deck.

Under the Constantinople rules the space between the frames (floor timbers) or between the ribs are exempt from dues, whatever the height of these frames or the thickness of the ribs. Water-ballast compartments situated in this space are thus exempt. The benefit of this exemption (letter of the president of the Suez Co., of June 11, 1897) has been extended to that portion of double bottoms for water ballast above the frames when these double bottoms are constructed according to the MacIntyre system—a system almost abandoned to-day—which does not carry the frames up to the ceiling of the water-ballast compartment. All other spaces are included in the gross tonnage for Suez, even if incapable of use for cargo, fuel, or provisions, as, for instance, the forward and after peaks and water-ballast tanks.

Spaces Exempted Above the Tonnage Deck.

WATER BALLAST.

Up to the present all water-ballast space above the tonnage deck has been measured.

A case has just arisen in England, however, in which a water-ballast space above the tonnage deck has been exempted for Suez tonnage.

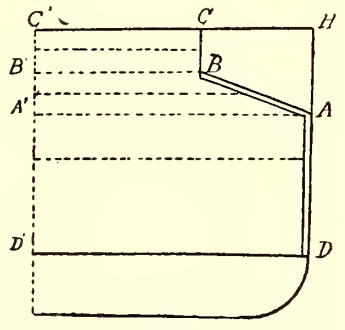


Fig. 2.

The rib BAD, at the point A, was bent in toward the inside of the vessel. Above and outside this rib there was a water-ballast compartment. The cross section was divided into three parts, considered separately.

CC'B'B—BB'A'A—AA'D'D.

The lower part was measured to the inside face of the rib.

The intermediate part to the inside face of the water ballast tank.

The upper part in the same way.

The water-ballast tank was thus excluded. The Suez Co. approved this treatment, which was proposed by the board of trade.

All other exemptions of space above the tonnage deck refer to spaces situated above the highest deck.

These exemptions, as in the national tonnage rules, are divided into two categories: (1) Those resulting from the special purpose of the space; (2) those resulting from the uninclosed character of the space.

[1] The measurement of superstructures is at present not carried out as for national tonnage. See p. 440 of this appendix, and pp. 400–401 of Appendix XI.

FRANCE. **ENGLAND.** **GERMANY.**

SPACES EXEMPTED BECAUSE OF THEIR PURPOSES.[1]

1. In each of the three countries, the hatchways, with a maximum of one-half per cent of the gross tonnage, as in the national tonnage rules.

In France the companionways, domes, and skylights are theoretically measured. As a matter of fact, they are often exempted.

2. In England and Germany: The companionways; also the part of the poop giving access to a stairway.

3. The volumes of ladders and stairways when they are located in space which is itself exempted.

4. The volumes of domes and skylights. In the case of an opening made in the floor of a superstructure immediately under a skylight to light and ventilate a dining saloon the exemption is extended to the entire space ABCD, of the figure below, which is considered necessary for the admission of air and light into the lower part.

At Bremen this exemption is not made.

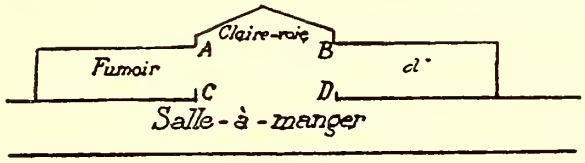


Fig. 3.

5. The volume of the engine-room ventilation, with the two following exceptions:[2]

(*a*) In France and Germany in the case of real deduction this volume is first measured and then deducted at its actual value.

(*b*) In England when the engine-room ventilation shafts are inclosed, wholly or in part, in inclosed superstructures, the uninclosed part alone is exempted from measurement. The inclosed part is added to the volume of the propelling machinery and deducted with an increase of 75 per cent. This is an unjustifiable practice.

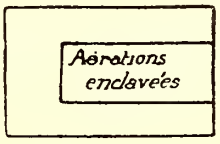


Fig. 4.

[1] Double bottoms used solely for water ballast are exempted from measurement.

[2] Engine-room ventilation: In each country the spaces intended for entrance of light and air to the engine room are included in gross tonnage if below decks or in inclosed superstructures which extend from side to side. Spaces in open superstructures are exempted. In case of fixed bunkers, actually measured, the light and air spaces in each country which were included in gross tonnage are deducted at their actual value as a part of the engine-room and bunker space. In case the Danube rule is applied in Germany only the light and air spaces between decks and under the bridge are included in the 75 per cent increment. Those in inclosed superstructures extending from side to side are not deducted. In England the light and air spaces between decks and under the bridge (if inclosed) are included in the 75 per cent increment. In addition, however, those in inclosed side-to-side superstructures above the first tier may upon written request of the owner be included in the increment, provided that the side-to-side spaces beneath it have been similarly treated and that the spaces so dealt with are not exempted for any other portion whatever. (Board of Trade instructions to surveyors August 1911.)

FRANCE.	ENGLAND.	GERMANY.
	A ventilating shaft is considered totally or partially inclosed when it is bounded on the whole or part of three sides by a closed construction.	

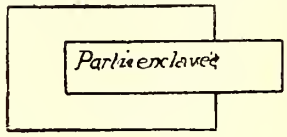


Fig. 5.

EXEMPTIONS BY REASON OF THE OPEN CHARACTER OF SPACES ABOVE THE UPPER DECK.[1]

Up to the present the new rules of 1904 have had no practical application except in England. Therefore, English practice only will be indicated.

According to the arrangement of 1904, which governs the treatment of deck spaces, the space is divided into three categories:

1. The spaces considered inclosed in the national tonnage. (See Appendix 8.) They are likewise considered inclosed for the Suez and have no right to any exemption.

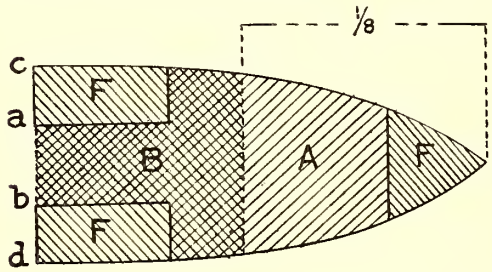
2. The spaces considered open for national tonnage and inclosed for Suez tonnage, to which the 1904 rules are applied.

3. The spaces considered open for the national tonnage and open for Suez tonnage. They are always exempted.

The dividing line between the first and second category is determined by the rules of the British registry. (See Appendix 8.)

The dividing line between the second and third will be defined:

(*a*) In case of space on a shelter deck—that is to say, under a continuous deck from end to end of the vessel—the openings in the deck are not considered. Only the openings in the sides are considered, and the space is exempt because of these openings by virtue of the 1904 arrangement, but under condition that this space be not occupied by cargo. If it were, it would be added once for all to the tonnage. Exemption under this head can not exceed nine-fortieths of the length of the vessel.



ab ◁ ½ cd.
FFF, closed spaces in English tonnage, measured and taxed.
A, the space of one-eighth exempt, under restrictions.
B, measured space.

Fig. 6.

(*b*) The forecastle space is exempted to the extent of one-eighth of the length of the vessel when there is in the afterface of the forecastle an opening of less than one-half the width of this face, the opening being considered easy to close. Exception to this special rule is, of course, made of spaces considered inclosed under the general English tonnage rules, and the same condition of no commercial use also obtains (fig. 6).

[1] Exemptions of portions of poop, forecastle, and bridge are allowed in Germany as defined in the Suez regulations. If the measurement boards judge shelter decks and superstructures to be permanently inclosed, such spaces are included, otherwise they are exempted.

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(*c*) The treatment in case of a poop is exactly analogous: When the forward face of the poop has an opening smaller than one-half of this face one-tenth of the length of the vessel is exempted, under condition of nonuse.

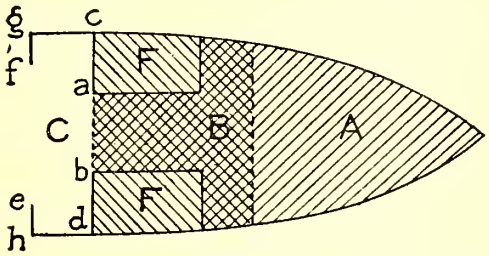

Fig. 7.

ef $\triangleright$ ½ gh and having no means of being closed.
ab $\triangleleft$ ½ cd.
FF, inclosed spaces in English tonnage measured and taxed.
A, space of one-eighth, exempted under restrictions.
B, measured space.
C, exempted space.

In case of the forecastle and poop, if the partition which has an opening of less than one-half the width of the space is located inside the end of the forecastle proper, the outer space would be exempt "by rights" (fig. 7) on condition that the opening of this space is greater than one-half the width of the space and has no means of being closed.

In case of a bridge:

(*a*) When each of the ends has an opening equal at least to one-half of the width of the end and not having any means of being closed, the entire space under the bridge is considered as open and is exempt "by rights" (fig. 8).

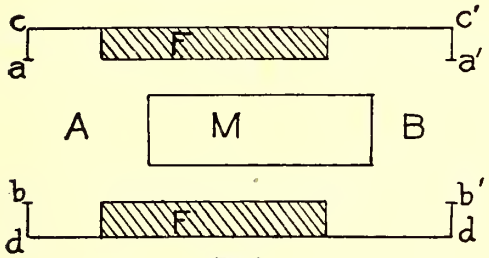

Fig. 8.

ab $\triangleright$ ½ cd
a'b' $\triangleright$ ½ c'd'
} and without means of being closed; whole space cc'd'd considered open and exempt except F and F', which are inclosed constructions according to the English rule and are measured and taxed.

(*b*) When neither end has an opening equal at least to one-half its width the entire space is considered closed for the Suez. In this case, under the 1904 arrangement the part of the space under the bridge belonging to the engine-room ventilators is exempted (fig 9).

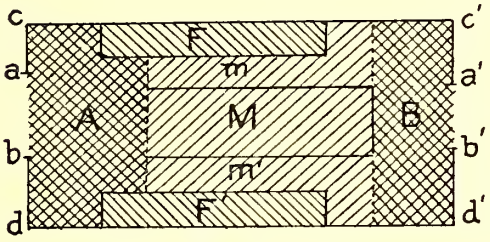

Fig. 9.

ab $\triangleleft$ ½ cd.
a'b' $\triangleleft$ ½ c'd'.
A, B, portions considered closed, measured and taxed. M, m, m' spaces belonging to engine room ventilators exempted by 1904 rules, except F, F', which are inclosed constructions according to the English rule and are measured and taxed.

(*c*) When only one end has an opening at least one-half the width of the end and without means of being inclosed, the space under the bridge is divided into three parts (fig. 10). (See following paragraph.)

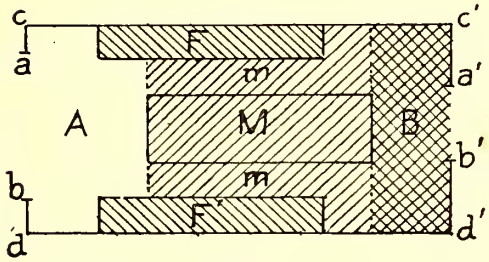

Fig. 10.

ab $\triangleright$ ½ cd without means of being closed.
a'b' $\triangleleft$ ½ c'd'.
M, m, m', spaces belonging to the engine-room ventilators, exempt under 1904 rules, except F, F', which are closed constructions under British registry and are measured and taxed.
A, space considered open, and thus exempted "by rights."
B, space considered closed, measured and taxed.

1. The part belonging to the engine-room ventilators exempted under the 1904 arrangement. 2. The part between the above part and the closed end is considered inclosed and is measured. 3. The part between the first part and the open end is considered open and exempted "by rights" from dues. The portion of the space under a bridge outside of the partition would be, as in the case of forecastle or poop, exempt "by rights." In a general way, then, the English practice admits that any opening greater than one-half the width of the space concerned gives this space an open character, but under condition that this opening has no means of being closed. A grating or a plate of sheet iron may be considered such a means. On this subject

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there are no precise rules; it is a question of good will on the part of the officials doing the measuring.

Moreover, it is admitted, as a principle, that there can be no exemption of a space situated above another space that has already benefited under the 1904 rules.

Finally, these exemptions of the 1904 rules are subject to the nonuse of the exempted spaces for commercial purposes.

Such as it is, this English practice does not seem to be complete. There should be added the necessary restrictions to prevent the exaggeration of the exemptions that are called, often wrongfully, "by rights" (hard and fast).

III.—Deductions.

A. General Deductions.

The total general deductions should not exceed 5 per cent of the gross tonnage.

CREW SPACE.

In England deduction is allowed only if the conditions required in the national tonnage rules are fulfilled.

In the term crew are included all the vessel's personnel, officers, petty officers, seamen, engineers, and stokers; but not the personnel of the passenger department, nor the steward. The doctor is included when there is one on board.

The spaces deducted as crew space in all three countries are:

1. The quarters themselves. (The cabin for a doctor, only when there is actually a doctor on board.)
2. The toilets for the exclusive use of the crew, whatever be their location. The wash rooms of the crew are not deducted unless they form part of a toilet that is deducted.
3. The wardrooms of the officers, with a limit of 4 tons, and of the petty officers with a limit of 2½ tons.
4. Bathrooms for officers and engineers with a limit of 2 tons.
5. The crew's galley.

NOTE.—There are often two galleys deducted, one of them being reserved for the native portion of the crew.

The passageways are not deducted in France or England.

In Germany, they are deducted when they are used exclusively for access to the crews' quarters or other deducted spaces, and when used as dressing room for the crew.

In England, all spaces deducted as crew space must be marked with a sign indicating their exclusive use for this purpose.

In Germany, the spaces deducted as crew space must bear a sign indicating their capacity.

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SPACES USED IN NAVIGATION.

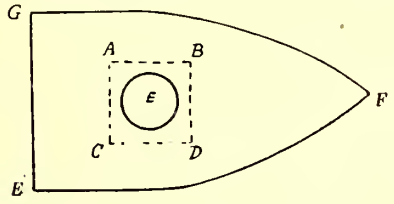
In the three countries the spaces deducted for navigation are:

1. Wheelhouse.
2. Lookout house.
3. Signal house.
4. Towers for running lights.

In Hamburg, towers for running lights are sometimes exempted instead of being deducted. In Hamburg, the lamp locker, if reserved for running lights only, is also deducted, it being considered a signal house.

5. Room for charts and navigation instruments (chart room). When the captain is quartered in this room, 3 tons only are deducted on account of the charts. This should not be confused with the supplementary deduction of 3 tons, allowed by the national rules, when the charts are kept in a space that is not deducted.

6. Capstan or windlass space, when it is on the upper deck. In the very rare case when the capstan or windlass is situated in a space not exclusively reserved for it deduction would in France be made only of the space occupied by the apparatus and necessary for its operation. (See ABCD, fig. 11.)



E, capstan.
ABCD, space necessary for its operation.

Fig. 11.

In Hamburg, there is a strong tendency to consider the entire space EFG as capstan space and deduct the whole. (See EFG, fig. 11.)

7. Steam steering-gear space (same remarks as for the capstan).

8. Auxiliary-boiler space, when this boiler is situated in an inclosed space on the upper deck and is used only to operate the capstan, windlass, or the steering gear.

NOTE.—In practice the auxiliary boiler is almost always used in the operation of the derricks for handling merchandise and therefore is almost never deducted except on war vessels.

B. Deductions for Propelling Machinery.

On vessels with coal bunkers with movable partitions, deduction is made according to the Danubian rule (i. e., 1.75 or 1.50 the actual machinery volume).

On vessels with fixed coal bunkers, the actual volume of the machinery and bunkers is deducted, if the owner so desires.

PRINCIPAL VOLUME.

The measurements are made in the same way as for the national tonnage. The Suez tonnage is thus indirectly benefited by the restrictions imposed on the dimensions by the rules of the different countries.

SPACES TO BE INCLUDED.

The spaces occupied by dynamos, distilling apparatus, refrigerating apparatus, machine shops, etc., are treated in the three countries as in the national tonnage rules.

VENTILATION SPACES.

In case the actual volume of the machinery and bunkers is deducted the engine-room ventilators in the 'tween decks and in inclosed superstructures are deducted at their actual value. The surplus is exempted. Nevertheless, in Germany all these spaces are, sometimes,

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measured (for the gross tonnage) and then deducted instead of being exempted. As a matter of fact there is no difference. In the case of deduction according to the Danubian rule, all engine-room ventilators situated in a 'tween decks space are considered as part of the machinery space and have a right to the increment. Shelter-deck spaces and spaces under a bridge considered as closed under the national rules are, in this respect, considered as 'tween decks.

In England, in addition, and wrongly, there is included in the volume of the machinery, with right to the increment, such part of the ventilators as lie outside of the 'tween decks and are inclosed on at least three sides in inclosed constructions.[1]

In a space under a bridge considered inclosed, in the national rules, the ventilators receive the same treatment as in 'tween decks.

In a space under a bridge considered open, in the Suez rules, the ventilators are simply, and rightly, entitled to exemption.

In a space under a bridge considered open under national rules, and not open under the Suez rules, the 1904 rules exempt the engine-room ventilators and also the space appertaining thereto.

In Germany, there is a tendency to consider an open space under a bridge as a 'tween deck space, and therefore to apply the Danubian increment to the ventilators therein.

In England, the exemption of engine-room ventilators at any stage entails their exemption at all stages above.

A deck space above another deck space is never treated as a 'tween-deck space.

VOLUME OF THE SHAFT TUNNEL.

In the three countries, it is treated as in the national rules. (See Appendix 8.)

[1] See note 2, p. 439, for present application in England.

APPENDIX XVII.

INSTRUCTIONS AND REGULATIONS RELATING TO THE MEASUREMENT OF SHIPS OF THE UNITED STATES NAVY FOR TONNAGE CERTIFICATES USED IN NAVIGATION OF THE SUEZ MARITIME CANAL.

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[Compiled and prepared by the scientific and computing branch of the Bureau of Construction and Repair, Department of the Navy, 1909.]

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REFERENCES.

For reference in connection with the question of tonnage, see:

(*a*) United States Statutes at Large, Revised Statutes United States, Nos. 4150 to 4154, pages 803 to 806.
(*b*) Supplement, Revised Statutes, United States, volume 1, act of August 5, 1882, page 378, chapter 398, act of June 19, 1886, page 494, chapter 421, section 5.
(*c*) Supplement, Revised Statutes, United States, volume 2, act of March 2, 1895, page 407, chapter 173.
(*d*) United States Statutes at Large, volume 35, part 1, Public Laws, act of February 6, 1909, page 613, chapter 82, section 1.
(*e*) Customs Regulations, 1908. (Treasury Department.)
(*f*) Navigation Laws, United States, 1907 (corrected). (Department of Commerce and Labor.)
(*g*) Instructions relating to the measurement of ships, 1907 (English).
(*h*) Regulations for the Navigation of the Suez Maritime Canal, 1907.
(*i*) Translation (Naval Intelligence). Instructions for the measurement of ships (German).
(*j*) Responses aux Questions de Tonnage concernant les Navires de Guerre. (C. & R. No. 6215A21 to 25.)
(*k*) Letter, Bureau of Navigation, Department of Commerce & Labor. (C. & R. No. 6563A7 and 8.)
(*l*) Letter No. 6215A19 and 20 in re rulings of the Suez Co.
(*m*) Report on certificate, U. S. S. *New York* (6215A8).
(*n*) Copy of Suez certificate for the U. S. S. *Abarenda* (25945E3).

NOTE.—Inasmuch as most of the above references are corrected and reissued at certain times, and as it is most desirable that the latest issues be had, it will be the duty of those computing tonnage in the scientific and computing branch of the Bureau of Construction and Repair, to secure, from time to time, through the proper channels, such reissues and also such new references as may be found to have a bearing on the question of tonnage.

GENERAL INSTRUCTIONS.

1. *Uniformity in measurements.*—These instructions are compiled for use in the preparation of tonnage certificates, upon which tonnage tolls may be collected, when ships of the United States Navy have occasion to pass through the Suez Maritime Canal, and it is of great importance not only that the following laws and regulations be followed, but that all the required measurements be taken, and calculations made, in one uniform and correct manner, so that one general system may prevail throughout.

2. *Features not covered by regulations.*—Whenever, in any calculation, new features arise, which are not clearly covered by these rules, instructions, etc., causing doubt as to method of procedure, the discussion thereof shall be referred to an officer of the bureau and his decisions relative thereto shall be appended to and made a part of these instructions; after reference to and approval by the Chief Constructor, if deemed necessary.

3. *Preparation of certificates.*—Suez Canal certificates of tonnage shall be prepared in full detail from careful calculations made in accordance with the following statutes, regulations, and instructions, and special care shall be exercised in their preparation in order that no incomplete or obscure entries shall appear in a certificate, which might constitute ground for investigation or possible remeasurement on the part of the canal authorities.

4. *Record of certificates.*—A full and careful record shall be entered in a book to be known as the tonnage book and in the general form of the certificate of the results of any and all tonnage calculations which may be made; also the drawings and figures made in connection with the preparation of any certificate shall be preserved in the files of the scientific and computing branch of the Bureau of Construction and Repair.

5. *Use of rule for laden ships.*—In general calculations measurements will be taken in the manner prescribed for unladen ships, whenever possible, but when, due to the absence of plans and records or to special hardships or difficulties, that method is rendered impracticable, the rule for laden ships may be employed. This condition will probably seldom arise, but the exception is inserted to cover a possible case.

6. *Remeasurement under rule for unladen ships.*—Any ship which may have, of necessity, been measured while laden, shall, at the earliest practicable time thereafter be measured in the usual manner, and the results thus obtained shall supersede such previous calculation.

7. *Ships previously under foreign flags.*—Whenever it becomes necessary to provide a Suez Canal certificate for any vessel which may have been previously registered under a foreign flag, and have had a foreign certificate issued to her prior to becoming the property of the United States, a new calculation shall be made in accordance with these instructions, and a new certificate shall be issued, which shall constitute the correct Suez tonnage for that vessel.

8. *Alteration of certificates due to changes.*—If after a certificate has been issued to any naval ship it becomes necessary to change or alter her by the addition or removal of any space which will affect the tonnage, such spaces shall be measured and a new certificate issued, which shall represent the correct tonnage of the ship after the addition or deduction shall have been made.

9. *Use of figures from a previous calculation.*—When in preparing the Suez certificate any vessel's national certificate of registry is available, it will not be always necessary to remeasure the tonnage under the uppermost deck, unless it is found that some space has been exempted in such certificate of registry that must, under these rules, be included, or vice versa, provided the certificate had been issued by a country which had previously adopted a system of tonnage measurement similar in its essential features to the system hereinbelow.

10. *Desirability of retaining original figures.*—Whenever changes in a ship's arrangement necessitate alterations in a certificate, it is to be understood that it is desirable that the original figures for below and 'tween deck spaces be retained, if possible; therefore, no new figures will be made for such spaces, unless directly affected by the changes in the ship, as the small differences, due to a new calculation, are of minor consequence and are to be avoided.

11. *Measurements from plans.*—Measurements taken from finished plans of any naval vessel, corrected to cover the latest arrangements affecting tonnage spaces, shall be considered to be as accurate and useful in the calculation of tonnage as dimensions lifted directly from the ship, inasmuch as these plans are taken from work under the direction of a representative of the Bureau of Construction and Repair.

12. *Sister ships.*—In determing the tonnage of sister ships, actually built from the same lines and molds, and having nearly similar arrangements, it will be necessary to calculate the similar portions in the case of one ship only; the results shall then be considered to apply equally well to any of such ships.

13. *Spaces reasonable in extent.*—In vessels of the Navy, all spaces as constructed or as altered shall be considered as being reasonable in extent, since it is clearly disadvantageous to the Navy to evade any tonnage dues at the expense of maximum efficiency of general arrangement of a ship's compartments.

14. *Certification of spaces.*—All spaces on vessels of the Navy shall be considered as having been properly certified, since it is usual on naval ships to clearly designate the use of a compartment by a name plate over the doorway or opening thereto.

15. *Fulfillment of requirements.*—The requirements for lighting, ventilation, and seaworthiness shall be considered as having been fulfilled in all spaces on United States naval vessels, whether assigned to officers, crew, machinery, for the passage of light and air, or for any other purpose.

16. *Accuracy of measurements.*—All general measurements will be sufficiently accurate if carried to the nearest hundredth of a foot.

17. *Deviation from method.*—Although the rules and regulations as hereinafter laid down will, in general, fully cover the measurement of ships of various forms and diversified construction, it must be borne in mind that in order to obtain a correct result when the prescribed method is inadequate in detail the geometrical formula best adapted to the results to be obtained shall be utilized.

18. *Exempted spaces.*—Should there be any spaces exempted in figuring the tonnage of a ship, such spaces should be enumerated on the certificate, and when no spaces are exempt that fact should be noted.

19. *To reduce tons to cubic meters.*—In order to change tons of 100 cubic feet each to cubic meters multiply by the factor 2.83.

GROSS TONNAGE.

In obtaining the gross tonnage of any United States naval ship the rules for measurement of ships of American register shall prevail (see Revised Statutes of the United States Nos. 4150, 4153, etc.), with such modifications as may be made necessary by the "Regulations for the Navigation of the Suez Maritime Canal."

1. *Definition of gross tonnage.*—The gross tonnage or total capacity of ships comprises the exact measurement of all spaces (without any exception) below the upper deck, as well as of all permanently covered or closed-in spaces on that deck.

2. *Definition of covered or closed-in spaces.*—By permanently covered and closed-in spaces on the upper deck are to be understood all those which are separated off by decks or coverings, or fixed partitions, and therefore represent an increase of capacity which might be used for the stowage of merchandise or for the berthing and accommodation of the passengers or of the officers and crew. Thus any one or more openings either in the deck or coverings, or in the partitions, or a break in the deck, or the absence of a portion of the partition, will not prevent such spaces being comprised in the gross tonnage, if they can be easily closed in after admeasurement and thus better fitted for the transport of goods and passengers. But the spaces under awning decks without other connection with the body of the ship than the props necessary for supporting them which are not spaces "separated off" and are permanently exposed to the weather and the sea will not be comprised in the gross tonnage, although they may serve to shelter the ship's crew, the deck passengers, and even merchandise known as "deck loads."

"Deck loads" are not comprised in the measurement.

3. *Shelter decks.*—In the case of shelter-deck spaces the whole of the space under the shelter deck is included in the tonnage measurement with the exception of that part of the space which is immediately abreast the openings (if there are any) in the sides of the ship.

4. *Definition of tonnage deck.*—The tonnage deck in vessels having three or more decks to the hull shall be the second deck from below; in all other cases the upper deck of the hull is to be the tonnage deck.

5. *Measurements.*—All measurements to be taken in feet and fractions of feet; and all fractions of feet shall be expressed in decimals.

6. *Method of measuring unladen ships* (Rule I).—The register tonnage of every vessel built within the United States, or owned by a citizen or citizens thereof, shall be her entire internal cubical capacity in tons of 100 cubic feet each, to be ascertained as follows:

BELOW TONNAGE DECK.

Measure the length of the vessel in a straight line along the upper side of the tonnage deck, from the inside of the inner plank, average thickness, at the side of the stem to the inside of the plank on the stern timbers, average thickness, deducting from this length what is due to the rake of the bow in the thickness of the deck, and what is due to the rake of the stern timber in the thickness of the deck, and also what is due to the rake of the stern timber in one-third of the round of the beam; divide the length so taken into the number of equal parts required by the following table, according to the class in such table to which the vessel belongs.

The classes shall be arranged as follows:

Class 1. Vessels of which the tonnage length, according to the above measurements, is 50 feet or under—into 6 equal parts.

Class 2. Vessels of which the tonnage length, according to the above measurements, is above 50 feet and not exceeding 100 feet—into 8 equal parts.

Class 3. Vessels of which the tonnage length, according to the above measurements, is above 100 feet and not exceeding 150 feet—into 10 equal parts.

Class 4. Vessels of which the tonnage length, according to the above measurements, is 150 feet and not exceeding 200 feet—into 12 equal parts.

Class 5. Vessels of which the tonnage length, according to the above measurements, is above 200 feet and not exceeding 250 feet—into 14 equal parts.

Class 6. Vessels of which the tonnage length, according to the above measurements, is above 250 feet—into 16 equal parts.

Then the hold being sufficiently cleared to admit of the required depths and breadths being properly taken, find the transverse area of such vessel at each point of division of the length, as follows:

Measure the depth at each point of division from a point at a distance of one-third of the round of the beam below such deck; or in case of a break, below a line stretched in continuation thereof, to the upper side of the floor timber at the inside of the limber strake, after deducting the average thickness of the ceiling, which is between the bilge planks and limber strake; then if the depth at the midship division of the length does not exceed 16 feet, divide each depth into 4 equal parts; then measure the inside horizontal breadth at each of the three points of division and also at the upper and lower points of the depth, extending each measurement to the average thickness of that part of the ceiling which is between the points of measurement, number these breadths from above, numbering the upper breadth one, and so on down to the lowest breadth; multiply the second and fourth by four, and the third by two; add these products together, and to the sum add the first breadth and the last, or fifth; multiply the quantity thus obtained by one-third of the common interval between the breadths, and the product shall be deemed the transverse area; but if the midship depth exceed 16 feet, divide each depth into 6 equal parts instead of 4, and measure as before directed, the horizontal breadths at the five points of division, and also at the upper and lower points of the depth; number them from above as before; multiply the second, fourth, and sixth by four, and the third and fifth by two; add these products together, and to the sum add the first breadth and the last, or seventh; multiply the quantities thus obtained by one-third of the common interval between the breadths, and the product shall be deemed the transverse area.

Having thus ascertained the transverse area at each point of division of the length of the vessel, as required above, proceed to ascertain the register tonnage of the vessel in the following manner:

Number the areas successively one, two, three, etc., number one being at the extreme limit of the length at the bow and the last number at the extreme limit of the length at the stern;

then, whether the length be divided according to the table into 6 or 16 parts, as in classes 1 and 6 or any intermediate number, as in classes 2, 3, 4, and 5, multiply the second and every even-numbered area by 4, and the third, and every odd-numbered area except the first and last, by 2; add these products together, and to the sum add the first and last if they yield anything; multiply the quantities thus obtained by one-third of the common interval between the areas, and the product will be the cubical contents of the space under the tonnage deck; divide this product by 100, and the quotient, being the tonnage under the tonnage deck, shall be deemed the register tonnage of the vessel, subject to the additions hereinafter mentioned.

BETWEEN DECKS.

If a vessel has a third deck, or spar deck, the tonnage of the space between it and the tonnage deck shall be ascertained as follows:

Measure in feet the inside length of the space, at the middle of its height, from the plank at the side of the stem to the plank on the timbers at the stern, and divide the length into the same number of equal parts into which the length of the tonnage deck is divided; measure also at the middle of its height the inside breadth of the space at each of the points of division, also the breadth of the stem and the breadth at the stern; number them successively one, two, three, etc., commencing at the stem; multiply the second, and all other even-numbered breadths, by 4, and the third and all the other odd-numbered breadths, except the first and last, by 2; to the sum of these products add the first and last breadths, multiply the whole sum by one-third of the common interval between the breadths, and the result will give, in superficial feet, the mean horizontal area of such space; measure the mean height between the plank of the two decks and multiply by it the mean horizontal area, and the product will be the cubical contents of the space; divide this product by 100 and the quotient shall be deemed to be the tonnage of such space, and shall be added to the other tonnage of the vessel, ascertained as above directed. And if the vessel has more than three decks, the tonnage of each space between decks, above the tonnage decks, shall be severally ascertained in the manner above described, and shall be added to the tonnage of the vessel, ascertained as above directed.

DECK HOUSES, BREAKS, ETC.

If there be a break, a poop, or any other permanent closed-in space on the upper deck available for cargo or stores, or for the berthing or accommodation of passengers or crew, the tonnage of that space shall be ascertained and added to the gross tonnage.

Measure the internal mean length of such space in feet and divide it into an even number of equal parts, of which the distance asunder shall be most nearly equal to those into which the length of the tonnage deck has been divided; measure at the middle of its height the inside breadths, namely, one at each end and at each of the points of division, numbering them successively one, two, three, etc.; then to the sum of the end breadths add four times the sum of the even-numbered breadths and twice the sum of the odd-numbered breadths, except the first and last, and multiply the whole sum by one-third of the common interval between the breadths; the product will give the mean horizontal area of such space; then measure the mean height between the planks of the decks and multiply by it the mean horizontal area; divide the product by 100, and the quotient shall be deemed to be the tonnage of such space, and shall be added to the tonnage under the tonnage decks, ascertained as aforesaid: *Provided*, That nothing shall be added to the gross tonnage for any sheltered space above the upper deck which is under cover and open to the weather—that is, not inclosed.

7. *Method of measuring laden ships* (Rule II).—In order to enable those who may be charged with the calculation of tonnage of ships of the United States Navy to properly interpret such figures as may appear in any certificate prepared by the Suez authorities themselves, it may be well to quote the method followed in the measurement of laden ships which have no certificate to accompany an application for passage through the canal.

The deductions from the gross are the same as those appearing under the heading "Net tonnage," but the total capacity or gross figure is arrived at as follows:

RULE II.—*For laden ships.*

ART. 9. When ships have their cargo on board, or when for any other reason their tonnage can not be ascertained by means of Rule I, proceed in the following manner:

Measure the length on the upper deck from the outside of the outer plank at the stem to the aft side of the sternpost, deducting therefrom the distance between the aft side of the sternpost and the rabbet of the sternpost at the point where the counterplank crosses it.

Measure also the greatest breadth of the ship to the outside of the outer planking or wales.

Then having first marked on the outside of the ship, on both sides thereof, the height of the upper deck at the ship's sides, girt the ship at the greatest breadth in a direction perpendicular to the keel from the height so marked on the outside of the ship, on the one side, to the height so marked on the other side, by passing a chain under the keel; to half the girth thus taken add half the main breadth; square the sum, multiply the result by the length of the ship taken as aforesaid; then multiply this product by the factor 0.17 in the case of ships built of wood and by the factor 0.18 in the case of ships built of iron. The product will give approximately the cubical contents of the ship, and the general tonnage can be ascertained by dividing by 100 or by 2.83, according as the measurements are taken in English feet or in meters.

ART. 10. If there be a break, a poop, or other permanent covered and closed-in spaces (as defined in the general principles) on the upper deck, the tonnage of such spaces shall be ascertained by multiplying together the mean length, breadth, and depth of such spaces, and dividing the products by 100 or 2.83, according as the measurements are taken in English feet or meters, and the quotients so obtained shall be deemed to be the tonnage of such spaces, and shall be added to the other tonnage in order to determine the gross tonnage or total capacity of the ship.

8. *Hatches.*—The cubical contents of the hatchways shall be obtained by multiplying the length and breadth together and the product by the mean depth taken from the top of beam to the underside of the hatch. From the aggregate tonnage of the hatchways there shall be deducted one-half of 1 per cent of the gross tonnage, and the remainder only shall be added to the gross tonnage of the ship exclusive of the tonnage of the hatchways.

9. *Open vessels.*—In ascertaining the tonnage of open vessels the upper edge of the upper strake is to form the boundary line of measurement, and the depth shall be taken from an athwartship line, extending from the upper edge of such strake at each division of the length.

10. *Inner bottom.*—In the case of a ship constructed with a double bottom for water ballast, if the space between the inner and outer plating thereof is certified by the collector to be not available for the carriage of cargo, stores, or fuel, then the depth of the vessel shall be taken to be the upper side of the inner plating of the double bottom, and that upper side shall for the purposes of measurement be deemed to represent the floor timber.

11. *Light and air spaces to machinery.*—On a request in writing to the Commissioner of Navigation by the owners of a ship the tonnage of such portion of the space or spaces above the crown of the engine room and above the upper deck as is framed in for the machinery or for the admission of light and air and not required to be added to the gross tonnage shall, for the purpose of ascertaining the tonnage of the space occupied by the propelling power, be added to the tonnage of the engine space; but it shall then be included in the gross tonnage; such space or spaces must be reasonable in extent, safe, and seaworthy, and can not be used for any purpose other than the machinery or for the admission of light and air to the machinery, or for the admission of light and air to the machinery or boilers of the ship.

12. *Use of exempted spaces.*—If at any time a vessel performs transit with cargo or stores carried in any portion of any exempted space, then the whole of that space is added to the net tonnage and can never more be exempted from measurement.

INSTRUCTIONS AND DEFINITIONS.

GROSS TONNAGE.

1. *Decks, not considered continuous.*—In deciding which deck fulfills the requirements for a tonnage deck, neither the platform decks when composed of several flats, nor the armored protective deck, shall be considered a complete deck, within the interpretation of the meaning of the law.

2. *Break decks, in two-decked ships.*—If the second deck from the keel, in a two-decked vessel, consists of several partial decks, extending, with breaks, from the stem to the stern, the line of that course of decks must be taken as the tonnage deck; and if the partial decks are at different heights, the line of the lowest flat will be taken as the tonnage deck and the headroom above such line and under the higher flats will be measured and added as inclosures above decks.

3. *Breaks, definition of.*—A break is the space above the line of the deck, when that deck is cut off and continued at a higher elevation. The height of a break is the distance from the underside of the deck cut off to the underside of the break deck.

4. *Breaks in inner bottom.*—When it is necessary to establish the below-deck volume of a vessel with an irregular or broken inner bottom, the length of the ship should be divided into sections, of lengths equal to the unbroken portions of the inner bottom lines, and after subdividing each of such sections into parts, according to the class under which the sections respectively belong, the volume of each should be calculated separately, in such manner as to determine, as exactly as possible, the volume of the hold. Where lengths of sections are 30 feet or under, they may be divided into two equal parts.

5. *Spring of beam.*—The round or spring of the beam is the perpendicular distance from the crown of the underside of the deck plank or plating at center to a line stretched athwart the vessel from end to end of the top of the beam, and it is to be ascertained at every place where it is to be used in the measurement.

6. *Half breadths at side.*—If there be no ceiling, plating, or planking on the inside of a ship's frames, the half breadths shall be taken to the inside of the frame members.

7. *Lowest breadths on sections.*—The bottom widths are to be taken only so far as the apparent flat of floor extends. Where there is a perceptible rise immediately from the keel, the bottom widths should be taken equal to the width of the keelson and no compensation made for the rise of floor or turn of the bilge.[1]

8. *Web-frame construction.*—For ships constructed with web frames, at intervals of the length, the measurements should be taken to the interior faces of the ordinary frames, ignoring the greater depth of the web-frame construction.

9. *Battens or spar ceiling.*—When the ceiling of a hold or other space is open in construction, and consists of battens spaced apart, the breadths should be taken to the inside of the average thickness of battens, between points of measurement.

10. *Insulation for refrigeration.*—When a ship's compartments are insulated for refrigerating or other purposes and the insulating material extends inboard of the frames or above the tops of floors or inner bottom, the half breadths and heights shall be taken to the inside of the average thickness thereof.

11. *Tonnage sections of irregular form.*—When any tonnage section is of such an irregular form, due to peculiar arrangement of the inner bottom or to any other cause, that the area will not be correctly produced by the ordinary method, such irregularities may be figured and added to or subtracted from the area found by the prescribed process, as the case may be.

12. *Volume of ram bow.*—That portion of a ship forward of the No. 1 tonnage section, known usually as the ram bow, and fitted with plate framing in which lightening holes are cut, shall be figured and added to the gross tonnage, but the breadths shall be taken to lines representing

[1] Attention is called to the English Merchants Shipping Act of 1894 as revised (see Eng., 1907, p. 33) showing their method of calculating volume below decks in ships with a rise of floors.

the inboard sides of frames of the same depths as those used in the forward end of the ship adjacent this space. The same method shall apply in the case of a projecting stern.

13. *Cement in tonnage spaces.*—Where quantities of cement are used in a ship's compartments, the volumes of the spaces are to be figured to the framing of the ship, as if the cement were not present.

14. *Ballast tanks not inner bottom.*—Peak tanks are not to be, in any case, exempt from measurement, and side ballast tanks are to be included in the gross tonnage, except when built without the inside of the framing of the ship, such, for instance, as the "Raylton Dixon System" of topside tanks, which may be exempted provided they are not used for cargo, stores, or fuel.[1]

15. *Feed water and fuel oil in bottoms.*—Spaces in the double bottoms, made tight for reserve feed water or fuel oil, are to be exempted from measurement, just as is done in the case of ordinary water bottoms for ballast water.

16. *Cofferdams.*—The cofferdams above the protective deck, and in general, are not to be considered exempted spaces, but are to be measured and included in the gross figures, except when actually forming a continuation of the inner bottom and when not used for cargo, stores, or fuel; cellulose being considered cargo in warships.

17. *Space at after end of shaft tunnel.*—The compartments through which the shaft tubes pass, abaft the tunnel and forward of the stuffing box, sometimes known as the stuffing-box compartment, will not be exempted in the figuring of tonnage, unless such space is made water-tight and forms the only inner bottom in the location considered. When forming a part of the after-peak tank space it is not to be exempted space.

18. *Between deck, poop, and forecastle lengths.*—When taking measurements for lengths, to the bow or stern, on ships, where framing is present instead of stem or sternposts, such measurement shall be taken at half the height of space concerned and to the inside of the frame, but when ceiling is fitted, the length shall be taken to the inside of the average thickness thereof.

19. *Heights between decks.*—In figuring the capacity of spaces where there occur several thicknesses of deck covering, the height shall be taken from the underside of the deck above to the average thickness of such deck planks or plates and coverings thereon as may be: *Provided,* The deck lines of the bounding decks are parallel or crowned to the same camber; otherwise the correction for difference in camber shall be made.

20. *'Tween deck spaces with breaks in sides.*—When figuring a space where gun sponsons, recentrant ports, or other breaks in the topside occur, the ordinates shall be taken to a line formed by a continuation of the inside line of the frames or the ceiling thereon; the volumes of the breaks shall then be calculated and added to or subtracted from the figure thus found; the result shall be considered the volume of such space.

21. *Shelter decks and upper decks; difference between.*—Whether for the purpose of measurement a deck is to be regarded as an upper deck or as a shelter to an upper deck, is to be determined in each instance, both by the character and structural conditions of the erection, and by the purpose to which the between-deck is devoted. If the deck is a continuous deck, fastened down and water-tight, sealing up the cylinder formed between the two decks, and making it a fit place for the stowage of cargo, like a hold, the deck is to be treated as an upper deck, and the space between it and the deck below is to be measured. If, however, the cylinder is open to the shipment of seas, and the space is not reasonably fit for the carrying of dry cargo, but is used only for cargo generally classed as "deck loads," such as cattle, horses, chemicals, oil in barrels, etc., then, usually, the deck is to be regarded as a shelter deck, and the space as "sheltered space above the upper deck, which is under cover and open to the weather, that is, not inclosed," and is not to be included in the recorded tonnage.

22. *Definition of closed-in spaces.*—By "closed-in spaces" is to be understood, spaces which are inclosed and protected from the action of the weather, even though large openings be left in the inclosure, and care will be taken that the intent of the law in this respect is not evaded.

[1] Neither the English nor the American law permits the exemption of tanks for water ballast which are built within the framing of the ship, but n both countries ballast tanks may be deducted, there being no limit of 5 per cent of the gross for deductions other than propelling-power spaces. (See U. S. Stat. L., vol. 35, Pt. I, act of Feb. 6, 1909, sec. 2, p. 613. "From the gross tonnage there shall be deducted any other space adapted only for water ballast certified by the collector not to be available for the carriage of cargo, stores, supplies, or fuel.")

23. *Permanent erections.*—Poops, bridge houses, pilot houses, steering screens, or other permanent erections, entirely or partially open at sides or ends, or with one or more openings in the sides, ends or in the covering deck, and not fitted with doors, hatches, or other means of closing them, or which may not be easily closed in, shall not be included in the gross tonnage, except when the spaces therein are available or actually fitted or used for cargo, stores, passengers, or crew, when they must be measured and form a part of the gross tonnage of the ship. This section must not be confounded with that portion of the rules referring to shelter or awning decks or to deck loads.

24. *Open deck spaces for berthing.*—Spaces under shelter decks, such as those under bridges, etc., which are not inclosed or readily inclosed, but are fitted with hammock hooks for berthing accommodations, shall not form a portion of the gross tonnage.

25. *Deck erections, dimensions to framing.*—In all cases the interior dimensions of deck spaces and erections shall be taken to the ceiling where such exists, but in the absence thereof, to the interior edge of the frames or supports for the walls of these spaces. Stiffeners on bulkheads shall be considered as supports, even though not connected to the beam above or deck below.

26. *Deck erections of irregular form.*—When deck spaces have irregular form, such that the general formula, indicated for the measuring of deck spaces, can not be applied to give correct results, the spaces should be subdivided into smaller portions, and each of these measured by the most convenient geometrical formula adapted thereto.

27. *Hammock houses and berthing.*—All closed hammock houses and closed or readily closed hammock berthing forming erections above decks shall be figured in the gross tonnage.

28. *Miscellaneous spaces.*—Ammunition hoists above decks, turrets, and barbettes, conning and signal towers, inclosures of windlass, steering gear, and other spaces for working the ship, and all other such miscellaneous spaces, if within the regulations pertaining to permanent erections, shall form a part of the gross tonnage of a ship, but masts, vents, and cowls, open hammock berthing, etc., are not to form a part of such gross figure.

29. *Companion hatches, skylights, and access trunks, above decks.*—Companion hatches, skylights, and access trunks, above decks are not to be considered under the head of hatches, but are to be ignored in the gross tonnage of a ship, except when used as striking down hatches and directly connected with or trunked down to spaces where stores or cargo are stowed. When a companion house is used as a smoking room, for instance, for the accommodation of passengers it is to be included in the gross tonnage under the head of deck houses.

30. *Hatches for coal passing.*—In considering the volume of hatches (in excess of $\frac{1}{2}$ per cent gross) the coal hatches or skylights for striking down bunker coal are not to be included. All such hatches shall be omitted from the gross figure, except in cases where they are trunked down to the bunkers, when they will be included in the gross and will form a part of the machinery deduction.

31. *Light and air spaces for machinery.*—The closed or readily closed spaces for light and air or hot-air escape from machinery spaces, on or above the upper deck, shall be considered a part of and figured in the gross tonnage, but such spaces are in no case to be classed under hatches unless used for striking down stores or cargo.

NET TONNAGE.

In procuring the net tonnage of any United States naval ship, for Suez Canal tolls, the deductions as permitted by the canal authorities and appearing in the "Regulations for the Navigation of the Suez Maritime Canal," of which the articles below are extracts, shall be followed.

Deductions to be Made From the Gross Tonnage in Order to Ascertain the Net Tonnage.

Art. 11. To find from the gross tonnage of vessels as above set forth the official, or net registered tonnage, either for sailing vessels or for steamships, the following mode of operation must be resorted to:

SAILING VESSELS.

(1) Art. 12. For sailing vessels deduct: The spaces exclusively and entirely occupied by the crew and the ship's officers, those taken up by the cookhouse and latrines exclusively used by the ship's officers and crew, whether they be situated above or below the upper deck; the covered and closed-in spaces, if there be any situated on the upper deck, and used for working the helm, the capstan, the anchor gear, and for keeping the charts, signals, and other instruments of navigation.

(2) Each of the spaces deducted as above may be limited according to the requirements and customs of each country, but the deductions must never exceed in the aggregate 5 per cent of the gross tonnage.

(3) The company allows the following spaces to be included in the deductions specified in article 12 of the regulations for the measurement of tonnage, provided the deductions do not, in the aggregate, exceed 5 per cent of the gross tonnage.

(*a*) The chart room, even when also used as a captain's cabin. When, however, the captain's accommodation comprises several rooms, one of which is the chart room, that room alone is deducted; but, in all cases, the room used as the chart room must, if it is to be deducted, be situated on the upper deck.

(*b*) The doctor's cabin, but only when the doctor himself is on board.

(*c*) A mess room, if there is one, for the exclusive use of the officers and engineers; or, if they exist, two mess rooms—one of them for the exclusive use of the officers, the other one for the exclusive use of the engineers.

A mess room, if there is one, for the exclusive use of the petty officers.

No deduction is allowed for the officers' mess room in ships having passenger accommodations, which are not also provided with passengers' mess room.

(*d*) Two bathrooms, if they exist—one for the exclusive use of the officers, the other one for the exclusive use of the engineers.

Where there is not a bathroom for the exclusive use of passengers, if one of the above is used by them, the other one only is deducted.

(*e*) All spaces fitted with lavatories, with or without a bath, for the exclusive use of the ship's officers, engineers, and crew.

(*f*) At a meeting of the administrative council of the Suez Canal Co., March 2, 1908, it was decided to include in the deductions for the net tonnage of vessels the spaces intended to hold the apparatus of the wireless telegraphy and the electric projector, as being useful for the maneuver of the vessel, and under reserve of the observation of the maximum total of 5 per cent of the gross tonnage. (See C. & R. No. 932/A–894 and 895.)

(4) The above-specified spaces can only be deducted if they bear a distinctly visible and permanent indication of their exclusive appropriation.

(5) Closed spaces for the use or possible use of passengers will not be deducted from the gross tonnage.

(6) Art. 13. The measurement of these spaces is to be effected according to the rules set forth for the measurement of covered and closed-in spaces on the upper deck; the result, obtained by deducting the total of such allowances from the gross tonnage, represents the net or register tonnage of sailing vessels.

STEAMSHIPS.

(1) ART. 14. For vessels propelled by steam or any other mechanical power deduct:

(*a*) The same spaces as for sailing vessels (art. 12) with the limitation to 5 per cent of the gross tonnage.

(*b*) The spaces occupied by the engines, boilers, coal bunkers, shaft trunks of screw steamers, and the spaces between decks and in the covered and closed-in erections on the upper deck surrounding the funnels, and required for the introduction of air and light into the engine rooms, and for the proper working of the engines themselves. Such deductions can not exceed 50 per cent of the gross tonnage.

(2) ART. 15. The measurement of the spaces allowed for both in sailing vessels and in steamships (sec. 1 of art. 14) is to be effected according to the rules set forth in articles 12 and 13 for sailing vessels.

(3) Spaces for which allowances are made in steamships only (sec. 2 of art. 14) are measured according to the following rules:

(*a*) SHIPS HAVING COAL BUNKERS WITH MOVABLE PARTITIONS.

ART. 16. In ships that do not have fixed bunkers, but transverse bunkers with movable partitions, with or without lateral bunkers, measure the space occupied by the engine rooms, and add to it, for screw steamers 75 per cent and for paddle steamers 50 per cent of such space.

By the space occupied by the engine rooms is to be understood that occupied by the engine room itself and by the boiler room, together with the spaces strictly required for their working with the addition of the space taken up by the shaft trunk in screw steamers and the spaces between decks which inclose the funnels and are necessary for the admission of air and light into the engine rooms.

These spaces are measured in the following manner:

Measure the mean depth of the space occupied by the engines and boilers from its crown to the ceiling at the limber strake, measure also three, or, if necessary, more than three breadths of the space at the middle of its depth, taking one of such measurements at each end and another at the middle of the length; take the mean of such breadths; measure also the mean length of the space between the foremost and aftermost bulkheads or limits of its length, excluding such parts, if there are any, as are not actually occupied by or required for the proper working of the engines and boilers.

Multiply together these three dimensions of length, breadth, and depth, and the product will be the cubical contents of the space below the crown.

Then find the cubical contents of the space or spaces, if there are any, between the crown aforesaid and the uppermost or poop deck, as the case may be, which are framed in for the machinery or for the admission of light and air, by multiplying together the length, depth, and breadth thereof.

Add such contents as well as those of the space occupied by the shaft trunk to the cubical contents of the space below the crown; divide the sum by 100 or by 2.83, according as the measures are taken in feet or meters, and the result shall be deemed to be the tonnage corresponding to the engine and boiler room which serves as basis for the deductions referred to.

If in any ship in which the space aforesaid is to be measured the engines and boilers are fitted in separate compartments, the contents of each shall be measured separately in like manner, according to the above rules, and the sum of their several results shall be deemed to be the tonnage of the engine rooms which serves, as aforesaid, as basis for the total deductions.

(*b*) SHIPS WITH FIXED COAL BUNKERS.

ART. 17. In ships with fixed coal bunkers measure the mean length of the engine and boiler room, including the coal bunkers. Ascertain the area of three transverse sections of the ship (as set forth in the rules given in arts. 3 and 4 for the calculation of the gross tonnage) to the deck which covers the engine.

One of these three sections must pass through the middle of the aforesaid length, and the two others through the two extremities.

Add to the sum of the two extreme sections four times the middle one, and multiply the sum thus obtained by the third of the distance between the sections. This product divided by 100, if the measurements are taken in English feet, or 2.83, if they are taken in meters, gives the tonnage of the space in question.

If the engines, boilers, and bunkers are in separate compartments, they are separately measured, as above set forth, and the results are added together.

In screw steamers the contents of the shaft trunk are measured by ascertaining the mean length, breadth, and height, and the product of the multiplication of these three dimensions divided by 100 or 2.83, according as the measurements are taken in English feet or in meters, gives the tonnage of such space.

The tonnage of the following spaces between decks, and in the covered and closed-in erections on the upper deck, is ascertained by the same method, viz:

(*a*) The spaces framed in around the funnels.

(*b*) The spaces required for the admission of light and air into the engine rooms.

(*c*) The spaces, if there are any, necessary for the proper working of the engines.

(4) ART. 18. Instead of the measurement of fixed bunkers, the rules for bunkers with movable partitions as set forth in article 16 may be applied.

(5) ART. 19. In the case of tugs the allowances are not limited to 50 per cent of the gross tonnage; all spaces occupied by machinery, boilers, and coal bunkers are deducted.

Nevertheless, if such vessels are not exclusively employed as tugs, the deductions in question can not exceed 50 per cent of the gross tonnage.

(6) The determination of deductions for coal spaces may be effected either by the rules of the European Commission of the Danube of 1871 or by the exact measurement of fixed bunkers.

INSTRUCTIONS AND DEFINITIONS.

NET TONNAGE.

1. *Deductible space.*—No space will be deducted from the gross tonnage, in ascertaining the net tonnage, unless it has been first included in the gross figure.

2. *General deductions for quarters.*—All spaces for the exclusive use of the persons duly inscribed on the ship's list, with the exception of those for the commanding officer, are deductible within the reserve of the maximum allowance of 5 per cent of the gross tonnage for the total of deductions other than for propelling machinery.

3. *Interpretation of rules relative to passengers, etc.*—Inasmuch as ships of the Navy are not engaged in commercial pursuits or fitted up for the transportation of persons unidentified with the ship's company for pecuniary gain, the fact that a passenger or passengers are forced to use spaces intended for use of and assigned to officers shall not prevent the inclusion of such spaces in the deductions, but in general no deductions are to be made for spaces assigned to the accommodation of passengers.

4. *Definition of passengers.*—The admiral, his chief of staff, and flag lieutenant shall be considered passengers, as shall also officers, enlisted men, or other persons who may be aboard of but not assigned to duty with a transport, hospital ship, etc., i. e., all persons not duly inscribed on the ship's list are passengers.

5. *Cargo or stores in quarters.*—Every space occupied by officers or crew as living spaces or appropriated for their use and deducted therefor shall be kept free from stores and merchandise of any kind, not being the personal property of those occupying such spaces, and no passengers shall be accommodated therein.

6. *Definition of cargo.*—On ships of war the term "cargo" shall include armament, ammunition, and military and naval equipment; on transports, food, stores, luggage, accouterments, and equipment for passengers; on hospital ships, food stores for passengers, medical stores, and hospital equipment; on colliers, cargo coal and coaling gear; on repair ships, tools, parts

for repairs and repair equipment; on ammunition ships, arms, ammunition, etc.; supply and refrigerator ships, cargo stores, etc.; tank steamers, cargo fuel oil; and on distilling ships, distilling machinery and distilled water.

7. *Crew's berthing spaces.*—The deductions for crew's spaces are governed by the following principles: When the greater part of a closed-in space is occupied by the mess tables, hammocks, and men's quarters, its entire area, after omitting ventilating shafts, if any, cabins, companion ways, etc., is to be deducted from the gross tonnage: *Provided,* Such parts of the space as are not occupied by mess tables, hammocks, etc., are not of such dimensions as to be available for other purposes. In the case of larger spaces, serving other purposes than as living quarters for the crew, e. g., for gun and torpedo armaments and in which hammocks and mess gear are distributed over the whole space, only that part is to be considered crew's space which is occupied by mess gear, hammocks, and crew's gear, inclusive of the space required for the use of the tables and benches. In general, only such portions of crew's spaces as are actually occupied and used by crew shall form the crew's deduction.

8. *Crew's spaces not fitted for berthing.*—When spaces are occupied by lockers, mess tables or other gear for the crew, but are not fitted for berthing, they shall form a part of the crew's deduction, provided they are used for no other purpose than the crew's accommodation.

9. *Crew's spaces on open decks.*—When crew's hammocks are swung on open or under shelter decks, as, for instance, under bridges, etc., open at sides or ends, no deductions shall be made unless the spaces in which such accommodations exist have been previously included in the gross figure.

10. *Hammock houses and hammock berthing for crew.*—Hammock houses and hammock berthing which is closed or readily closed shall form a part of the crew's berthing deduction, provided, however, such spaces shall have first been included in the gross tonnage.

11. *Stewards, cooks, and messmen.*—Passengers' stewards, cooks, and messmen are not considered part of the crew on passenger steamers. On troop ships, transports, or other naval auxiliaries stewards, etc., who are regularly listed on the ship's complement may be deducted for, even though at times used in the service of passengers, but in cases where such service of passengers is performed by servants shipped for the purpose no deduction shall be made.

On warships (which invariably carry no passengers except official representatives of the Government) the messmen, etc., shall be considered as forming a part of the crew, and their spaces shall be deducted for.

12. *Captain's quarters.*—The captain's quarters when below decks are not to be deducted for, and when above decks only such portion thereof as is used as a chart room is to form a deduction even though permitted as a deduction in the register tonnages of some nations.

13. *Passages and officers' country.*—Where open spaces, known as country or passage, are fitted with hammock hooks, lockers, etc., for the use of officers or crew they shall be deductible as berthing spaces, but otherwise such spaces shall form no part of the deduction.

14. *Galleys, bakeries, sculleries, and pantries.*—Under the heading of "Cookhouse deduction" the galleys, bakeries, sculleries, and pantries, except spaces especially assigned to the commanding officer or fleet officers, may be included, provided they are used in the preparation of food for persons duly inscribed on the ship's list. Galleys, etc., for the accommodation of passengers will not be deducted.

15. *Bathrooms, lavatories, etc.*—All latrines, lavatories, bathrooms, showers, urinals, and water-closets shall be deducted for, except those provided for the use of the captain or fleet officers and those assigned to passengers.

16. *Mess rooms.*—All mess rooms provided for persons duly inscribed on the ship's list, except the captain or fleet officers, shall form deductible space, but no passengers' mess rooms shall be deducted.

17. *Sick bay, dispensary, and sick bay bath.*—Any spaces provided for the medical attention of the officers and crew of a ship are to form a part of the deductions thereon, but in the case of a hospital ship having spaces fitted for the transportion or treatment of others than those duly listed on the ship's complement no such deductions shall be made therefor.

18. *Doctor and medical attendants.*—The accommodation for the doctors, apothecary, and sick attendants shall form a part of the deductions even in cases of hospital ships when they are duly inscribed on the ship's list.

19. *Spaces for working ship.*—The windlass house, steering-gear space, conning towers, lookout houses, pilot houses, capstan spaces, signal spaces, wireless rooms, etc., shall be deducted when located above the deck covering the highest 'tween deck, or when perhaps under a simple shelter deck, but when below decks such spaces are not to be deducted.

20. *Donkey boiler and engine.*—The donkey boiler and engine, when in an inclosed space above decks, and when connected up with any or all of the auxiliaries—for instance, pumps, steering gear, anchor gear, windlass, capstan, etc.—is to be deducted, but when also used for the purpose of hoisting cargo, as in some merchant ships, it does not form deductible space, except in the case of men-of-war or troop ships, which do not carry cargo for commercial purposes. (See also No. 36, p. 461.)

21. *Steering-engine and windlass-engine spaces.*—The spaces for the steering and windlass engines, etc., are to form a part of the miscellaneous deductions for working the ship, provided they are situated above the uppermost deck; and if located in open space and not bulkheaded off a maximum space of 3 feet on each side for access and attendance will be permitted.

22. *Signal spaces and lamp room.*—Signal towers or inclosed signal stations above decks may be deducted when used only for signals or signal apparatus connected with the ship, and when the lamp room is above and used for signal lamps only the same may be deducted under this heading.

23. *Ballast tanks.*—Peak tanks and side ballast tanks are in no case to be deducted from the gross tonnage, although such deductions are permitted in the national tonnages of several countries, but in certain cases topside tanks form exempted space. (See also par. 14, p. 452.)

24. *Sail rooms and boatswain's stores.*—Sail rooms and boatswain's stores do not form deductible spaces under these regulations, even though they be deducted for under the national tonnages of the several countries.

25. *Cleaning-gear spaces.*—The places provided for the stowage of deck gear and other articles used in cleaning the ship are not to form a part of the deductions under these rules.

26. *Laundry, ice-machine, and refrigerator spaces.*—Laundries, ice-machines, and refrigerator spaces are not to form a part of the deductions under these rules, even though provided only for the officers and crew.

27. *Offices and storerooms.*—Offices provided on a ship for the transaction of routine business, except perhaps the doctor's office, are not to be deducted for; and no storerooms are to form a deduction, except possibly the navigator's and signal storerooms, and then only when above decks.

28. *Prisons and band rooms.*—Prisons and band rooms do not form deductible space, except when fitted up for the berthing, messing, or living quarters of the band, in which case a deduction may be made for such portions thereof as are so used.

29. *Propelling-power deduction.*—In ascertaining the amount of deduction for propelling power, whichever of the rules (*a*) or (*b*) produces the greater deduction for propelling power shall be used.

(*a*) (The Danube rule.) The actual engine, boiler, shaft alley, and light and air spaces as measured plus 75 per cent of these spaces for screw steamers, and plus 50 per cent for paddle steamers; or

(*b*) The actual measurement of the above spaces plus the actual measurement of the permanent bunkers which can not be extended or increased in size.

30. *Motive power other than steam.*—In ships provided with motive power other than steam the machinery spaces shall be figured and deducted as in steam-propelled vessels.

31. *Goods or stores in machinery spaces.*—No goods or stores shall be carried in any spaces measured and deducted for propelling power; but spare parts, tools, oil, waste, and the like may be carried in machinery spaces, provided they are not within bulkheaded spaces, separated off from the machinery space proper.

32. *Cabins or storerooms in machinery spaces.*—When cabins, engineers' storerooms, etc., are located in machinery spaces, they shall not form a part of the propelling-power deductions, but shall be omitted therefrom.

33. *Engineers' workshop, dynamos, and distillers.*—The engineers' workshop, dynamos, and distillers are not to form a part of the propelling-power deductions in a steamship, unless located directly in a machinery space and not bulkheaded off therefrom; but when a distiller is used only for the preparation of potable water for the crew and not used for making steaming water the space therefor may be deducted under the 5 per cent reserve clause for miscellaneous spaces.

34. *Crank pits and pockets.*—All crank pits, pockets, etc., for main and auxiliary machinery in the engine and boiler rooms shall form a part of the propelling-power deductions.

35. *Auxiliary machinery in propelling-power spaces.*—When auxiliary machinery is located in the propelling-power spaces, it shall be included in the deduction for the propelling power, but shall not be entitled to a separate deduction under any other head.

36. *Donkey boiler in propelling space.*—If the donkey engine and boiler are within the boundary of the machinery space, and are used in connection with the main machinery, they are to be included in the propelling power deduction, and the space occupied by them shall not be entitled to a separate deduction in addition.

37. *Machinery or fittings in fidleys.*—Whenever machinery or fittings are located in the engine or boiler room uptake casings, and no bulkhead incloses them except the casings bulkhead, the whole or entire volume of these uptake spaces shall form a portion of the deduction for propelling power, but when the auxiliary machinery is bulkheaded off from the rest of the space, such portions as may have been inclosed for such machinery or fittings shall not form a portion of the propelling power deduction.

38. *Engine and fireroom blower.*—When blowers for machinery spaces are located in, or are in a compartment adjacent to, the machinery spaces, they shall form a part of the machinery deduction of the ship; in general, all spaces for the ventilation of machinery compartments situated below the upper deck are considered as forming a part of the propelling power deduction.

39. *Air casings.*—When machinery spaces are fitted with air casings, the air spaces are to be included in the propelling power deductions as they form part of the ventilation of such spaces.

40. *Light and air casing not extending to top of inclosed space.*—Whenever, in the case of an otherwise inclosed superstructure, large but readily closed openings, surrounding the funnels, are provided in the cover deck, and the entire volume of such space is figured in the gross tonnage, only such portions of the light and air casings from the boiler and engine rooms as may actually extend into such spaces shall be figured in the propelling power deduction, even though such casings do not extend up to the cover deck but stop at or in proximity to the deck below such cover deck.

41. *Light and air spaces above decks.*—All portions of light and air spaces to propelling machinery up to the gratings or plates covering them are to be included in the machinery deduction, even such portions as extend above the deck inclosure, provided they have been included in the gross tonnage.

42. *Movable bunkers.*—When the "Danube rule" is not used, but actual bunker space as well as actual machinery is measured and deducted, the bunkers are to be measured separately and added together, but none are to be included in such deductions which can in any way be extended or increased in volume by the means of movable partitions or bulkheads.

43. *Methods of taking measurements in bunkers.*—When using actual volume of bunkers for fuel deductions, the measurements are to be taken to the under side of deck and inside of frames and not to under side of beams and outside of frames as are required in standard bunker capacities.

44. *Coal trunks.*—All fixed coal trunks shall be considered as having been included in the 75 per cent space deduction for fuel, when using the "Danube rule," but when the actual

capacity of the fuel spaces is used, the coal trunks and chutes are to be figured and added thereto, as forming a part of the fuel space.

45. *Fuel oil tanks.*—When part of the double bottom is fitted up for the carrying of oil fuel for the ship's fires in an ordinary coal burning vessel, no deduction shall be made for such space, since it is exempted space not measured for gross tonnage, but in cases of oil-burning ships the fuel tanks thereof, except double-bottom tanks, shall be considered as fuel compartments and figured in the propelling power deduction similarly to coal bunkers.

46. *Shaft tunnels with a raised flat under.*—The deductions for shaft alleys in cases where a shaft alley flat is fitted above the inner or outer bottom plating, should not include the space below such flat, but should be measured only to the floor plates thereof, provided such plates, although nonwater-tight, form a complete floor for the compartment. In other cases figure to the bottom of the compartment as if the incomplete flat were not fitted.

47. *Shaft tunnels not clearly defined.*—When shaft tunnels are not clearly defined by bulkheads and the ship is more or less open, only such portions as are necessary about the shaft and thrust block shall constitute a deduction. The thrust block space should be taken of such length and breadth as to admit of a man's getting around it to remove the holding down bolts, and the height shall not exceed 7 feet except when more space is absolutely necessary. The shaft space need not exceed 6 feet headroom and 3 feet passage on one side with clearance on the other side. When the ship is open from side to side and the space abaft the engine room through which the shafts pass is used for cargo stores, etc., no deduction shall be made.

METHOD OF PROCEDURE.

In figuring the Suez tonnage of any vessel the mode of procedure, after the necessary finished plans, lines and mold loft dimensions are in hand, shall be as follows:

1. Ascertain what spaces are exempt from measurement, if there are any, and what deck constitutes the tonnage deck.
2. Make sketch of stem and stern contours and obtain the below and 'tween deck lengths.
3. Lay out below and 'tween deck sections at the proper stations and figure offsets and heights thereon as may be necessary for obtaining areas.
4. Calculate the below deck volume, omitting exempted spaces, and including necessary appendages.
5. Figure volume of 'tween deck spaces from areas found.
6. Figure deck erections coming within the requirements, from detail sketches if necessary.
7. Obtain volume of hatches in excess of $\frac{1}{2}$ of 1 per cent of above spaces.
8. From above volumes obtain the "Gross Suez Canal tonnage."
9. Determine volume of the spaces assigned to crew's and officers' berthing and also such other miscellaneous spaces as may be properly deductible up to 5 per cent of the gross figure, and deduct the same.
10. Lay out such sketches as may be necessary and calculate the volume of the machinery spaces.
11. Determine from the types and capacities of the several bunkers whether the "Danube rule" or actual bunker capacity is to be used in the propelling power deduction.
12. Obtain the propelling power deduction up to a maximum figure of 50 per cent of the gross tonnage.
13. Deduct the propelling power figure from that found after deducting for berthing, etc., and secure the "Net Suez Canal tonnage."
14. Prepare a certificate in accordance with the above figures, after checking same, and issue such certificate to the ship.
15. Record certificate in tonnage book and file actual calculations.

CLASSIFICATION OF ITEMS UNDER THEIR PROPER HEADINGS IN THE CERTIFICATE.

1. Gun turrets and barbettes are to appear under the heading "Roundhouses" when entering volumes in the certificate.

2. Closed hammock berthing (when above decks) shall be included under the heading "Side houses."

3. Light and air spaces to machinery (when extending above decks) shall appear under "Spaces necessary for working the ship."

4. "Berthing accommodations of crew" is to include only berthing and messing spaces therefor.

5. "Berthing accommodations of officers" is to include staterooms, doctor's cabin, and officers' mess rooms, bathrooms, lavatories, water-closets, etc.

6. The miscellaneous deductions are to include galleys, crew's water-closets and wash rooms, sick bays, and such properly deductible spaces as may be necessary for working the ship.

7. The "Engine room as measured" shall include that portion of "light and air spaces for machinery" which extends above decks.

RÉSUMÉ.

The gross tonnage for the Suez Canal shall include:

A. 1. Space below the tonnage deck, except exempted space.
2. Space forward of number one ordinate, in the bow.
3. Space abaft the last ordinate, in the stern.

B. Space between decks, above tonnage deck.

C. Spaces above uppermost complete deck (if closed in or readily closed) as follows:

1. Poop.
2. Bridge space.
3. Forecastle.
4. Turtlebacks and hoods.
5. Breaks in decks.
6. Turrets.
7. Barbettes.
8. Gun sponso s.
9. Gun housings.
10. Torpedo housings.
11. Ammunition hoists.
12. Range-finding stations.
13. Directing stations.
14. Engineer's workshops.
15. Carpenter shop.
16. Blacksmith shops.
17. Laundries.
18. Drying rooms.
19. Ice machine spaces.
20. Dynamo rooms.
21. Distiller rooms.
22. Conning towers.
23. Signal towers.
24. Lookout houses.
25. Lamp rooms.
26. Pilot houses.
27. Steering-gear spaces.
28. Steering-engine rooms.
29. Windlass houses.
30. Chain lockers.
31. Winch houses.
32. Capstan houses.
33. Donkey engine and boiler houses.
34. Chart houses.
35. Closed steering screens.
36. Wireless rooms.
37. Searchlight houses.
38. Storerooms.
39. Prisons.
40. Band rooms.
41. Deck-gear spaces.
42. Offices.
43. Staterooms.
44. Mess rooms.
45. Saloons.
46. Smoking rooms.
47. Companion houses.
48. Hammock houses.
49. Hammock berthing.
50. Crew's quarters.
51. Officers' quarters.
52. Captain's quarters.
53. Admiral's quarters.
54. Fleet staff's quarters.
55. Passengers' quarters.
56. Servants' quarters.
57. Sick bay.
58. Dispensary.

59. Medical attendants' quarters.
60. Galleys.
61. Bakeries.
62. Pantries.
63. Sculleries.
64. Water-closets.
65. Urinals.
66. Latrines.
67. Bathrooms.
68. Showers.
69. Lavatories.
70. Wash rooms.
71. Water-tank compartments.
72. Cofferdams.
73. Cargo spaces.
74. Light and air spaces for machinery.
75. Coal bunkers and trunks.
76. Cargo hatches in excess of one-half of one per cent gross.

The following spaces are exempted from measurement:

1. The double bottoms, except peak tanks.
2. Side ballast tanks, provisionally.
3. Masts above decks.
4. Vents and cowls above decks.
5. Open steering screens.
6. Companion hatches.
7. Skylights.
8. Tanks on deck, not part of hull structure.
9. Lockers on deck, not part of hull structure.
10. Spaces under open shelter decks.
11. Spaces for "deck loads."
12. Spaces not inclosed or readily inclosed.

The following spaces may be deducted in securing the net tonnage, up to a maximum of 5 per cent of the gross:

A. *Only if above deck—*
1. Navigator's storeroom.
2. Conning towers.
3. Lookout houses.
4. Signal houses.
5. Pilot houses.
6. Closed steering screens.
7. Windlass houses.
8. Chain lockers.
9. Winch houses.
10. Capstan houses.
11. Donkey boiler and engine spaces, provisionally.
12. Chart houses.
13. Steering-gear spaces.
14. Steering-engine rooms.
15. Wireless houses.
16. Searchlight spaces.
17. Lamp rooms for signals.

B. *Whether situated above or below decks—*
1. Crew's berthing and messing and living spaces wherever located.
2. Officers' berthing and messing and living spaces wherever located.
3. Cooks', servants', etc., quarters, provisionally.
4. Doctors', medical attendants', and apothecary's quarters.
5. Sick bays, except on hospital ship.
6. Dispensaries, except on hospital ship.

B. *Whether situated above or below decks*—Con.
7. Doctors' offices.
8. Galleys, except passengers', captain's, and fleet officers'.
9. Bakeries, except passengers', captain's, and fleet officers.'
10. Pantries, except passengers', captain's, and fleet officers'.
11. Sculleries, except passengers', captain's, and fleet officers'.
12. Mess rooms, except passengers', captain's, and fleet officers'.
13. Water-closets, except passengers', captain's, and fleet officers'.
14. Urinals, except passengers', captain's, and fleet officers'.
15. Latrines, except passengers', captain's, and fleet officers'.
16. Bathrooms, except passengers', captain's, and fleet officers'.
17. Showers, except passengers', captain's, and fleet officers'.
18. Lavatories, except passengers', cap tain's, and fleet officers'.
19. Wash rooms, except passengers', captain's, and fleet officers'.
20. Hammock berthing.
21. Hammock houses.
22. Condenser space—crew's drink only.

The following spaces shall not form a part of the deductions from the gross, which are under the restriction of the 5 per cent clause:

1. Turrets.
2. Barbettes.
3. Gun sponsons.
4. Gun and torpedo housings.
5. Ammunition hoists.
6. Range-finding and directing stations.
7. Armories.
8. Workshops.
9. Ice-machine spaces.
10. Dynamo rooms.
11. Distiller spaces, except as above.
12. Laundries.
13. Drying rooms.
14. Cargo-hoist spaces.
15. Open steering screens.
16. Storerooms.
17. Boatswains' stores.
18. Sailrooms.
19. Prisons.
20. Band rooms (unless quarters).
21. Deck gear spaces.
22. Offices.
23. Water-tank compartments.
24. Peak tanks.
25. Topside tanks.
26. Cofferdams.
27. Cargo spaces.
28. Captain's quarters, except chart rooms.
29. Admiral's quarters.
30. Fleet staff's quarters.
31. Passengers' quarters.
32. Passengers' servants' quarters.
33. Passengers' luggage rooms.
34. Passengers' water-closets, lavatories, etc.
35. Passengers' mess rooms and saloons.
36. Smoking rooms.
37. Companion houses.
38. Hospitals and dispensaries on hospital ships.
39. Engineers' machine shops.
40. Refrigerator spaces.
41. Cargo spaces.
42. Passages.
43. Open country.
44. Double bottoms.
45. Masts.
46. Vents and cowls.
47. Companion hatches.
48. Skylights.
49. Open spaces for deck loads.
50. Spaces under shelter decks.

The following spaces shall be included in the propelling power deduction, the total of which shall not exceed 50 per cent of the gross tonnage:

1. Engine room.
2. Crank pits.
3. Pump pockets in machinery spaces.
4. Air locks.
5. Vent spaces and trunks for machinery spaces.
6. Boiler rooms.
7. Blower rooms for forced draft.
8. Shaft alleys.
9. Thrust block pockets.
10. Donkey boiler and engine spaces, provisionally.
11. Fidleys.
12. Light and air spaces above decks.
13. Air casings, for insulation, if within machinery spaces.
14. Auxiliary machinery spaces in main machinery compartments.
15. Coal spaces.
    (*a*) Actual capacity of bunkers and trunks thereto.
    (*b*) 75 per cent machinery space for screw steamers or 50 per cent for paddle steamers.
16. Fuel oil, in other than double bottom compartments which are exempt from measurement in gross.

The following spaces are not to form part of machinery deduction when bulkheaded off from machinery space proper, or forming a separate space therefrom:

1. Dynamo rooms.
2. Distiller spaces.
3. Engineers' workshop.
4. Storerooms in machinery spaces.
5. Donkey engine and boiler when not in or immediately adjacent to machinery spaces.
6. Staterooms in machinery spaces.

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APPENDIX XVIII.

REPORT OF THE BRITISH ROYAL COMMISSION ON TONNAGE.—1881.

APPENDIX XVIII.

REPORT BY HER MAJESTY'S COMMISSIONERS APPOINTED TO INQUIRE INTO THE PRESENT OPERATION OF THE LAW FOR THE MEASUREMENT OF TONNAGE.

[Presented to both Houses of Parliament by command of Her Majesty, August, 1881.]

COMMISSION ISSUED BY QUEEN VICTORIA APPOINTING THE MEMBERS OF THE ROYAL COMMISSION ON TONNAGE.

VICTORIA R.

Victoria, by the grace of God of the United Kingdom of Great Britain and Ireland Queen, Defender of the Faith.

To our trusty and well-beloved Charles Morgan Norwood, Esq.; our trusty and well-beloved Sir John Stokes, knight commander of our most honorable Order of the Bath, colonel in our Corps of Royal Engineers; our trusty and well-beloved Sir Edward James Reed, knight commander of our most honorable Order of the Bath; our trusty and well-beloved Henry Cadogan Rothery, Esq.; our trusty and well-beloved Thomas Gray, Esq.; our trusty and well-beloved James Porter Corry, Esq.; our trusty and well-beloved Robert Capper, Esq.; our trusty and well-beloved John Glover, Esq.; our trusty and well-beloved Thomas Dyson Hornby, Esq.; our trusty and well-beloved William Pearce, Esq.; our trusty and well-beloved Thomas Bland Royden, Esq.; and our trusty and well-beloved Barnard Waymouth, Esq., greeting:

Whereas we have deemed it expedient that a commission should forthwith issue to inquire into the present operation of the law for the measurement of tonnage, and to report to us whether the principle of the present law is fully and properly carried into effect, and whether the terms of the present rules are suitable to the present state of shipbuilding, and to report whether the law is fair in its operation as between those who pay and those who receive dues on shipping, and as between the different classes of those who pay such dues; and to report whether, having regard to the great changes which have taken place in the character of merchant ships, there are any defects in the form, the build, or the user of such ships which can be traced to the present law of tonnage, or which any amendment of that law would remedy; and to report whether, having regard to just principles of taxation, to the convenience and furtherance of trade, to international arrangements, and above all to safety, it is desirable to make any and what alteration in such law:

Now know ye, that we, reposing great trust and confidence in your ability and discretion, have nominated, constituted, and appointed, and do by these presents nominate, constitute, and appoint you, the said Charles Morgan Norwood, Sir John Stokes, Sir Edward James Reed, Henry Cadogan Rothery, Thomas Gray, James Corry, Robert Capper, John Glover, Thomas Dyson Hornby, William Pearce, Thomas Bland Royden, and Barnard Waymouth to be our commissioners for the purposes of the said inquiry.

And for the purpose of enabling you, our commissioners, to make the said inquiries we do hereby authorize you and empower you, or any three or more of you, to invite all such persons as you may judge most competent, by reason of their situation, knowledge, or experience, to

afford you correct information on the subject of this inquiry; to attend before you and bring with them all such books, documents, papers, accounts, etc., as may appear to you, or any three or more of you, calculated to assist you in the execution of the trust hereby reposed in you.

And we will and command that this our commission shall continue in full force and virtue, and that you, the said commissioners, or any three or more of you, may from time to time proceed in the execution thereof and of every matter and thing therein contained, although the same be not continued from time to time by adjournment.

And for your assistance in the execution of these presents we do hereby authorize and empower you to appoint a secretary to this our commission to attend you, whose services and assistance we require you to use from time to time as occasion may require.

Given at our Court at St. James, the 11th day of October, 1880, in the forty-fourth year of our reign.

By Her Majesty's command:

W. V. HARCOURT.

REPORT.

To the QUEEN'S MOST EXCELLENT MAJESTY:

We, Your Majesty's commissioners appointed to inquire into the present operation of the law for the measurement of tonnage, humbly beg leave to present to Your Majesty the following report on the several matters referred to us:

Uses to which tonnage is applied.

1. The tonnage inscribed on the certificate of registry of a British ship constitutes the measure of her contribution to light dues, and to harbor and dock charges in British and many foreign ports. It is the measure of the amount to which a shipowner may become liable for any damage caused by his ship. It also has most important mercantile uses in connection with the purchase, sale, hire, and chartering of ships.

Considerations involved in inquiry.

2. An inquiry into the principle of the law on which the admeasurement of ships is founded, into the manner in which it is carried into effect, and into its bearing on the seaworthiness of ships, therefore involves considerations of great pecuniary interest to the large number of persons who receive dues on shipping, as well as to the general body of shipowners who pay them. It also involves the more difficult considerations affecting the manner in and extent to which the payment of tonnage dues by the various descriptions and classes of vessels of our mercantile marine shall be regulated, so as to insure equality of treatment between ship and ship.

Opportunities afforded for full expression of opinion on behalf of interests affected.

3. Bearing these considerations in mind, it has been our special care to afford ample opportunity for full expression of opinion on the part of all parties affected; and in response to our invitation, representatives of various interests from the ports of London, Newcastle, North and South Shields, Sunderland, Hartlepool, Hull, Southampton, Bristol, Cardiff, Newport, Holyhead, Dublin, Belfast, and Cork, have attended our sittings in London, and have tendered themselves for examination. We also deemed it desirable to visit the great shipowning and shipbuilding industries on the Mersey and the Clyde, and we held meetings for the reception of evidence and the inspection of the docks and shipping at Liverpool and Glasgow, at which latter port representatives from Greenock and Leith also attended. We have further invited and received the opinions and suggestions of persons of official and scientific authority upon the subject matter of our inquiry.

Present basis for tonnage measurement. (17 & 18 Vict., c. 104.)

4. The statute under which tonnage is admeasured is an act passed in Your Majesty's reign, known as "The Merchant Shipping Act of 1854," and the basis for tonnage adopted therein is a roomage or space ton of 100 cubic feet; and the tonnage is the roomage or the internal cubical capacity of the ship

below her uppermost deck, and of permanent closed-in spaces on her uppermost deck, available for cargo, stores, passengers, or crew, ascertained by the formula known as "Sterling's rule." The aggregate cubic space in the ship thus ascertained (designated in units of 100 cubic feet) constitutes her gross tonnage. This system was adopted in 1854, after much discussion, under the advice of Mr. Moorsom, who was also its first administrator.

Net or registered tonnage ascertained by deductions from gross tonnage. (30 & 31 Vict., c. 124, s. 9.) Deductions for crew space allowed to all descriptions of vessels.

5. The net or registered tonnage, upon which (with slight exceptions) all tonnage dues and charges on ships are levied, is ascertained in the case of sailing vessels by deducting from the gross tonnage the tonnage of spaces exclusively appropriated to the accommodation and use of the crew. The provisions in the act of 1854 in respect of crew spaces have been modified and extended by the merchant shipping amendment act, 1867, which provides that crew spaces may be deducted from tonnage wherever situated, provided certain conditions as to space, light, ventilation, and other sanitary arrangements be complied with to the satisfaction of a surveyor of the Board of Trade and that the spaces be kept free from goods and stores of any kind, not being the personal property of the crew in use during the voyage. We may remark here that there is no fixed limit by our law on the amount of crew space, whereas other maritime countries, as a rule, adopt the maximum limit of 5 per cent on the gross tonnage of the ship.

Allowances to steamers for propelling power.

6. In addition to the deduction for crew space (allowed to all descriptions of vessels), the gross tonnage of steamers is further reduced by an allowance for spaces occupied by and necessary for propelling power.

The deductions for propelling power which the owner of a steam vessel is entitled to claim are specified under section 23 of the act of 1854, as follows:

(*a*) As regards ships propelled by paddle wheels in which the tonnage of the space solely occupied by and necessary for the proper working of the boilers and machinery is above 20 per cent and under 30 per cent of the gross tonnage of the ship, such deduction shall be thirty-seven one-hundredths of such gross tonnage; and in ships propelled by screws, in which the tonnage of such space is above 13 per cent and under 20 per cent of such gross tonnage, such deduction shall be thirty-two one-hundredths of such gross tonnage.

(*b*) As regards all other ships, the deduction shall, if the commissioners of customs and the owner both agree thereto, be estimated in the same manner; but either they or he may in their or his discretion require the space to be measured and the deduction estimated accordingly; and whenever such measurement is so required the deduction shall consist of the tonnage of the space actually occupied by or required to be inclosed for the proper working of the boilers and machinery, with the addition in the case of ships propelled by paddle wheels of one-half, and in the case of ships propelled by screws of three-fourths, of the tonnage of such space.

After deducting from gross tonnage the allowance for crew space, and the allowance for space occupied by propelling power, the remainder is the register tonnage of a steam vessel.

By whom measurement taken.

7. The duty of taking the prescribed measurements for gross and net tonnage devolved, under the act of 1854, upon the commissioners of Your Majesty's customs, but by the Merchant Shipping Act, 1872, it was transferred to the Board of Trade.

No complaint as to mode of application of present rules but which are appropriate to wooden vessels only.

8. We have received no complaint whatever as to the manner in which those departments have applied the rules for taking the prescribed measurements; but representations have been made to us that the wording of the rules themselves (the measurements being described as from or to floor timbers, limber strakes, bilge planks, etc.) is appropriate only to vessels constructed of wood; and although the rules with their obsolete wording have been applied to iron ships, with results that have been sufficiently accurate for general purposes, yet the great changes of late years in the design and methods of construction

and in the dimensions of iron vessels render it necessary that special rules be enacted, defining more distinctly the points to and from which measurements should be taken and permitting greater discretion and elasticity in fixing the number of areas, and ordinates, so as to ascertain the contents with greater accuracy.

Difficulty of applying present rules to modern shipbuilding. Water-ballast double-bottom systems.

9. As an instance of the difficulty of applying the present rules to the progress of modern shipbuilding our attention has been called to the novel principle of construction of water-ballast double bottoms, as exemplified in the steamship *Chilka*. Under the mode which prevailed until recently, known as the McIntyre system, the water-ballast space extended above the floor plates (held to be identical with the floor timbers in wooden ships), and therefore was partly included in the internal space in the ship and measured in the tonnage, in conformity with section 21, subsection 2, of the act of 1854; but on another system of construction, called the bracket or longitudinal, the floor plates are carried to the top of the double-bottom space, and the depth of the hold of the ship, as measured, only extends to the top of that structure. Hence arises the anomaly that under the wording of the rules the double-bottom water-ballast space in a ship constructed under what is called the McIntyre system is in part measured and the contents added to the tonnage of a ship, whilst a water-ballast space of similar dimensions under the bracket system of construction, as adopted in the *Chilka* and other modern ships, is not measured nor included in either gross or register tonnage.

Development of steam power.

10. It is proper when adverting to the great changes since 1854 in the dimensions and forms of ships and of the material used in their construction that we should also notice the rapid development in the application of steam power to merchant vessels consequent on the general adoption of the screw propeller, and the great economy in the consumption of fuel and in the space necessary for carrying it, effected by the use of steam at greatly increased pressure, and of the high and low pressure cylinders in what are called "compound engines."

Increase of steam vessels between 1854 and 1880.

The progress in the production and use of steam vessels is shown by the following statement of the number and tonnage of sailing and steam vessels above 50 tons, registered under the Merchant Shipping Acts, which belonged to the United Kingdom (exclusive of the Isle of Man and Channel Islands), 1854 and 1880:

	Steam.		Sailing.		Total.	
	Number.	Tonnage.	Number.	Tonnage.	Number.	Tonnage.
1854	937	290,239	15,553	3,609,294	16,490	3,899,583
1880	3,786	2,688,769	11,569	3,545,528	15,355	6,234,297

Deduction of crew spaces approved and further exemption suggested.

11. The exemption of crew spaces from the register tonnage, and consequently from payment of dues, is generally acknowledged to have been attended with beneficial results, inasmuch as many shipowners have been encouraged to set apart for the use of the crew accommodation much superior to that previously given; and a suggestion has now been made that the master's cabin (if not used for passengers or cargo) should also be included in the crew space, and the contents deducted from gross tonnage. On the other hand, we have it in evidence that the increased deduction for crew space under the Merchant Shipping Amendment Act, 1867, sensibly affected the revenue of dock companies derived from dues on shipping.

Deduction for propelling power in steamers.

12. As regards the operation of the law in respect of the deduction of space in steamers for propelling power we find a general concurrence of opinion that the existing allowances are neither equal in their operation nor based on any sound principle discernible under the present conditions of steam navigation.

Representations of harbor and dock authorities respecting this deduction.

Harbor and dock authorities lay much stress upon the fact that the deduction of 32 per cent on the gross tonnage, under rule (*a*), now generally claimed by screw cargo steamers of recent build and with engines of moderate power, frequently gives to propelling space an allowance greatly in excess of that actually occupied by the engines, boilers, and fuel; and, further, that the space allotted by the shipbuilders to the engines and boiler is regulated so as to conform, with great nicety, to the condition of cutting off a space something just above 13 per cent of the gross tonnage in order to secure the deduction of 32 per cent from the gross tonnage. Numerous instances are given to us of such steam vessels discharging grain and other dead-weight cargo from distant ports largely in excess of the cargo that could be discharged by sailing vessels of the same register tonnage; and we are informed that when most dock acts were obtained steamers either did not exist or formed a much less proportion of the entire shipping tonnage than at present. According to the evidence of the representatives of some of the dock companies the register ton then represented about 27 hundredweight of cargo, and now indicates in the case of some steamers as much as 40 hundredweight. The conclusion urged upon us is that the 32 per cent allowance operates in many cases to the disadvantage of the receivers of dues on shipping and to the owners of sailing vessels, and of the many steamers, in which the size of the engine and boiler rooms has been regulated by the space necessary for the proper working of the machinery, and not by the arbitrary standard of 13 per cent on gross tonnage.

Unequal operation of allowances for propelling power to screw steamers.

13. It is pointed out to us that the allowances for propelling power apply to steamers irrespectively of the trade in which they are employed and the duration of the voyage. A screw steamer engaged in a coasting trade and making her passage in a few hours (provided she has an engine and boiler space exceeding by a small fraction 13 per cent of her gross tonnage) claims and receives, under rule (*a*), the same deductions for propelling power (32 per cent) as she would be entitled to were she trading with ports in the China Seas or on the west coast of America. In the former instance her allowance for fuel space of nearly 19 per cent of her gross register is very greatly in excess of the bunker needs for a voyage of a few hours, whereas in the latter case her allowance may not give a deduction equivalent to the space necessary to contain sufficient fuel to propel her halfway to her destination. The inequality of the allowance under the alternative rule (*b*), which applies to screw vessels in which the actual space occupied by the engine and boilers is less than 13 per cent and more than 20 per cent, is stated to be equally objectionable, though in a less degree, both in principle and practice.

To paddle steamers.

14. As respects paddle steamers, although from the small number of these vessels now in existence the inequalities in the deductions to which they are entitled under the rules (*a*) and (*b*) are less important to the receivers of dues, yet they are even more extreme and anomalous in the results. Instances appear in the appendix to the evidence annexed to this report of the register tonnage of paddle cargo and passenger steamers being less than one-fourth of their gross tonnage, and in the case of the steam tug *Clyde*, of Greenock, her tonnage is registered as minus 4.64, her gross tonnage being 87.72 tons, and her deductions 92.36. We have it in evidence that this vessel occupies space in harbors and

docks without the authorities being able to levy any dues whatever upon her for the accommodation she enjoys.

Anomalous results of such deductions.

15. The following table, based on rules (*a*) and (*b*) of section 23 of the act of 1854, will show the unequal and anomalous result of the working of these rules for the deduction of space in steamers for propelling power:

[For every 100 tons gross register.]

Engine room as measured.	Allowance (tons).	Net register tonnage.
	PADDLE STEAMERS.	
Tons.		*Tons.*
10	10+5=15	85
20	20+10=30	70
21	37 per cent.	63
29	do.	63
30	30+15=45	55
67	67+33.5=100.5	Nil.
	SCREW STEAMERS.	
10	10+7.5=17.5	83.5
13	13+9.75=22.75	78.25
14	32 per cent.	68
19	do.	68
20	20+15=35	65
58	58+43.5=101.5	Nil.

Case of the *Isabella*.

16. There is a further and quite novel deduction from the gross tonnage of steam vessels which it is necessary for us to notice.

The London and North-western Railway Co., who are the owners of steam vessels employed in the conveyance of passengers, cattle, and goods between Holyhead and Ireland, in applying in 1879 for a register for their new paddle steamship *Isabella*, claimed, in addition to the contents of engine and boiler spaces measured, plus 50 per cent (under subsection (*b*), sec. 23, of the act 1854), a further deduction of the contents of engine-room skylights and boiler casings above the deck, plus 50 per cent thereon, notwithstanding that such contents had not previously been measured and included in the gross tonnage.

The Board of Trade resisted this construction of the law as being contrary to the spirit of the acts of 1854 and 1867, but agreed to refer the matter, as a special case, to the High Court of Justice. The claim of the owners of the *Isabella* was confirmed, and her net register tonnage now stands at 337.90 tons against gross 842.40 tons, and the tonnage of the *Lily* and the *Violet*, two more recent steamers belonging to the same company, are, respectively, gross 1,035 tons and register 230 tons.

Principle on which law administered prior to case of the *Isabella*.

17. The principle on which the tonnage laws were administered, until the case of the steamship *Isabella* arose, was that in making deductions from the gross tonnage the contents of spaces never included in the gross should not be measured for the purpose of being deducted from it.

From 1854 to 1879 this principle appears to have been asserted by Your Majesty's Government, acquiesced in by the British shipowner, and adopted by every maritime country of importance, and in accordance therewith the board of customs first, and the Board of Trade afterwards, instructed their surveyors that spaces above the uppermost deck, such as cabin and engine-room skylights, cabin companions, funnel casings, and ventilating spaces, being places which are not suitable for the berthing or accommodation of passengers or crew or the carriage of stores or cargo, should be disregarded altogether, in the same way that the funnel is disregarded, and is not included in either the gross or the register tonnage. Acting, however, on the decision in the *Isabella* case, certain spaces above the uppermost deck, though not included in the gross tonnage, are now measured so that their contents may form a deduction

from the tonnage arrived at by the measurement of underdeck spaces; and that is not all, as in the case of the engine-room skylights, air boxes, and ventilating spaces not only the contents of the space itself but half as much again is deducted from gross tonnage. We are satisfied that such a construction of the acts is due only to defects in expression, and that it is inconsistent with the principle and intention of the law, as well as with justice and convenience.

Arguments of shipowners in support of existing deductions for propelling power.

18. It is however urged by some shipowners, in reply to the complaint by the receivers of dues as to the excessive deductions for the propelling power referred to in the four preceding paragraphs, that there has been a large extension of dock accommodation at our principal ports in recent years, and that it has not been alleged that the operation of the tonnage law has in any case prevented the construction of docks or the obtaining of capital for that purpose; that the keen competition that has been shown to exist between dock and dock in some cases, and between port and port in other cases is the chief cause of some dock and harbor authorities receiving less revenue than they could wish; that the basis for dock charges should include the element of the time during which water and quay space is occupied by the ship; that steam vessels on an average remain in harbor or dock for a much shorter period than do sailing vessels, and that measured by this standard they contribute more than sailing vessels to the revenue of docks, and that steamer business is preferred by dock authorities. It is further urged that steamers like the *Isabella*, making short passages and frequent visits to a port, pay very largely in dues, notwithstanding their reduced tonnage. It is alleged that it was the intention of the legislature, by the liberal exemption of propelling space in the act of 1854, to foster and encourage steam vessels; that the same necessity exists at present, and that the heavy costs attendant upon their working renders any addition to port charges at home and abroad, by an increase of tonnage, undesirable and oppressive; and that large investments of capital, both in construction of steamships and of dock accommodation, have been made on the strength of the law as it now operates.

It is further alleged that the 32 per cent deduction being conditional upon the engine room measuring more than 13 per cent of the gross tonnage leads in many cases to the construction of large engine rooms, which conduce to the health of the engine-room hands and to the safety of the ship.

Admitting these statements as fair arguments in favor of the existing deductions for propelling space, we do not think they are valid reasons in favor of an extension of these deductions, which goes beyond the intention of the settlement of 1854 nor against a revision of such settlement, rendered necessary by the great alteration of late years in the form, dimensions, and construction of ships and of marine engines, and by the great economy effected in the consumption of fuel.

In support of exempting water-ballast space in double bottoms.

19. The case of the steamer *Chilka*, in which the water-ballast space is constructed on the bracket floor or cellular system, raised the question whether the water-ballast space in the double bottom should or should not be exempted in all cases, however it may be constructed. Many shipowners urged that this space should be entirely excluded from measurement, for such reasons as the following: That it is not freight-earning space; that cargo can not be carried in it; that the double bottom is a source of strength and safety; that vessels have been saved from foundering through being so built; that in the case of heavy cargoes it is found advantageous by raising the weight; and that vessels so constructed do not require dock or harbor facilities for loading or unloading ballast.

Present tonnage laws do not operate against seaworthiness.

20. The operation of the law of tonnage, as it affects the seaworthiness of ships, has occupied much of our attention. The decided preponderance of evidence is to the effect that considerations of a saving of tonnage dues do not operate with shipowners in the building a ship in the form and of the dimensions most suitable to their purpose, and we have no distinct instance adduced to us to the contrary. But whether this be so or not, we have received abundant and unanimous testimony that in construction, design, speed, economy, and safety, the British merchant ship of the present day is not only vastly superior to the British ship of a date prior to the present law of tonnage, but that great improvements have been effected within the last 10 years. We have before us the fact that under the old tonnage law, by which the depth of a ship was not measured but was assumed to be about half the breadth, ships were made abnormally deep; and if not actually made dangerous thereby, were a very bad type of ship.

Open spaces on decks considered.

21. It has, however, been represented to us by persons whose opinions on the subject are well entitled to respectful consideration, that greater safety at sea would be secured if open spaces on the main deck of ships were covered in, which they assert would be done were not the owners discouraged by the operation of the law, which requires that such covered-in spaces be measured into and increase the tonnage of and consequently the charges upon the ship.

"Well-deck" steamers.

22. One type of steamship, of which the number is very large, has on the after part of the upper deck one of either of the following arrangements, viz:

(*a*) A short poop or break.

(*b*) A long poop or break extending to the bridge house, and constituting a continuous erection.

On the fore part of the deck there is a topgallant forecastle, and the space on deck between these erections is uncovered. This type of ship is commonly known as the "well-deck" ship; and whenever in the evidence the "well-deck" ship is referred to this type of ship is meant.

It has been urged by those who advocate that covered-in spaces on deck should be exempted from measurement of tonnage, that the covering in of the "well" would greatly add to the seaworthiness of the ship by increasing the freeboard and preventing the lodgment of water on the main deck, now uncovered; but repeated evidence has been given us by owners, builders, and masters of "well-deck" ships that experience proves them to be specially adapted for the safe conveyance of cargo, and that the losses at sea of such ships have been below the average. It is asserted that they are sailed with a larger proportionate surplus buoyancy than most "three-deck" ships, and that should the well be covered in a large cargo space would be created and utilized, and the vessel would be liable to be immersed beyond her former depth, and her average freeboard might be no greater than before the alteration.

The step found necessary by Lloyd's Registry in fixing a load line for awning-deck ships, which without that load line were often found to be too deeply laden, supports this assertion.

We are of opinion that the exemption of any closed-in space from measurement into tonnage, as an inducement to owners to increase the safety of ships, is unsound in principle, and if adopted would have to be followed by new restrictions, upon which fresh complaints would be founded.

"Awning-deck" steamers.

23. The proposal made to us that special encouragement should be given to the construction of vessels with an awning or shelter deck, and to the covering in of spaces on the main deck, such as exist in "well-deck" ships, by an entire or partial exclusion of the spaces thus made from tonnage, and consequently from payment of dues, is not one in which we are able to concur.

A ship with an awning or light upper deck, provided her draft is fixed so as to insure that the main deck be sufficiently out of the water, and that she is properly stowed, is unquestionably a specially safe and, in some trades, a specially profitable type of ship. She has, as a rule, a satisfactory amount of freeboard, and if fitted with open bulwarks and secure deck fastenings, no considerable amount of water can obtain a lodgment upon her deck or penetrate into her hold. At the same time it must be admitted that this type of ship is not so suitable and profitable for shallow harbors and heavy cargo as the single or the "well-deck" ship, and certainly is not so stoutly built as a ship known as a "three-deck" ship. We are of opinion that all these types of ships have their special uses and advantages, and if properly constructed, loaded, and handled are to all intents and purposes seaworthy ships.

Tonnage laws not intended to influence construction of ships.

24. It seems to us that the law for admeasurements of tonnage was not intended to raise, and should not raise or determine in itself, any question of seaworthiness or fitness, nor favor any particular arrangement, construction, form, or design of a ship. It was meant to be a system whereby the cubic contents of a ship should be ascertained accurately, and properly recorded, and the act of 1854 merely provides for the measurement of a ship when it is built, and leaves it to the owner to build his ship as he pleases.

Owners not influenced by tonnage dues in construction of suitable ships.

25. We do not conceive that owners are deterred by considerations of increased tonnage and payment of dues from making their ships suitable for the trade in which they are to be engaged; and we are of opinion that the increased roomage obtained by giving a ship an awning deck, or its equivalent, can, and in many instances would, be utilized for passengers, cattle, or other cargo, with profit to the owner. To exempt such spaces from payment of tonnage dues would be to give one type or class of ship a considerable advantage in competition with another equally seaworthy type, and that at the expense of the harbor and dock proprietors. It might also happen that under reckless or incompetent management such a space would be filled with heavy cargo; and in that case the exemption which was intended to prevent danger might be found to have led to it.

Tonnage laws should be colorless in their operation as regards construction of ships.

26. In fine, we are of opinion that on the one hand the law for the admeasurement of tonnage should not operate to produce a faulty or unseaworthy ship nor on the other hand to foster or encourage any one type of ship to the disadvantage of another.

Proposals and suggestions for change in the basis of tonnage system.

27. Proposals have been made to us by persons of experience and authority for a radical change in the basis of tonnage.

These proposals come to us in several forms:

(1) That it should be the amount of dead-weight cargo (in tons of 20 hundredweight) which a ship could carry on a fixed load line.

(2) That it should be the weight of the displaced water between a fixed light line and a fixed load line (which is practically equivalent to the above); the tons of weight (or the equivalent in cubic feet, calculated at 35 cubic feet to 20 hundredweight) being reduced by a divisor so as to give a result approximating to present register tonnage, adding thereto, in the case of passenger ships, a proportion of contents of the space used by them.

(3) That it should be the cubical contents or the displacement of the hull of the ship below a fixed load line.

A suggestion has also been made that tonnage as a basis on which to measure the contribution by ships for harbor and dock accommodation is unnecessary, and that the simple and more equitable basis on which to levy those dues would be the extent of water and quay space occupied, as shown by

the length, breadth, and depth of the ship, and the time the spaces and accommodation are occupied by her.

Gross tonnage as a basis of taxation.

28. Another suggestion is that gross tonnage (under the present system of measurement), without any deductions whatever, should be the basis of taxation, and that dues on steamers should be levied at a lower rate per ton than on sailing vessels.

Difficulties involved in inquiry committed to commissioners.

29. Before considering these proposed new systems, as well as the suggestions for the amendment of the existing law, we would advert to the wide scope of the inquiry committed to us and to the great difficulties which surround the subject arising from the variety of types of ships, their many differences in form, construction, dimensions, and material, the varied uses and employment to which ships are put, the specialities of the ports to which they trade and of the seas which they traverse, the diversity of the cargoes, animate and inanimate, which they carry, and, lastly, the inequalities arising out of the mode of propulsion.

Interest of harbor and dock authorities must be considered.

30. The interests of harbor and dock authorities have to be considered in relation to any change in the basis of taxation on ships, and accordingly we have obtained much interesting information as to the chief ports in the United Kingdom, the extent of accommodation afforded by the receivers of dues, of their powers of taxation, of their revenue and disbursements, and of their liabilities to their shareholders and others for due payment of interest on the moneys expended in affording accommodation to shipping.

International engagements. (25 & 26 Vict., c. 63, s. 60.)

31. Our international engagements as to tonnage form another important element of consideration.

The Merchant Shipping Act Amendment Act, 1862, section 60, enables Your Majesty by order in council to declare that when it is made to appear to Your Majesty that the rules concerning the measurement of tonnage of merchant ships for the time being in force have been adopted by and are in force in any foreign country the ships of such foreign country shall not be remeasured in British ports, but shall be deemed to be of the tonnage denoted in their national papers to the same extent and for the same purposes as the tonnage denoted in the certificates of registry of British ships.

32. The following countries have been declared by various orders in council to have fulfilled the conditions named in the above section, viz, the United States, Denmark, Austria-Hungary, Germany, France, Italy, Spain, Sweden, the Netherlands, Norway, Greece, Finland, and Russia, all having adopted our system of internal cubical capacity, and the gross tonnage of the ships belonging to those countries corresponding closely with that of British ships, as does the register tonnage of sailing vessels; but the deductions from gross tonnage of steamships to arrive at their net register under our law are not universally adopted, as will be seen by the following short statement, viz:

The United States allow no deductions from gross tonnage.

Denmark, Spain, Holland, and Greece deduct from gross tonnage all spaces solely for the crew and working of the ship, with a limit of 5 per cent on gross tonnage, and for propelling power in screw steamers 1.75, and in paddle steamers 1.5, of the tonnage of the actual engine and boiler space, with a limit of 50 per cent on the gross tonnage.

Austria-Hungary, Germany, Italy, Norway, and Russia deduct from gross tonnage all spaces solely for the crew, with a limit of 5 per cent on gross tonnage, and in steamers the space occupied by the machinery, boilers, and fuel, with a limit of 50 per cent on the gross tonnage.

France, Sweden, and Finland, with some slight variations, adopt the provisions of the English law as to deductions for crew space and propelling power, but place a limit of 5 per cent on gross tonnage upon crew space, and a limit of 40 per cent on the gross tonnage in the case of France and of 50 per cent in the case of Sweden upon propelling space deductions.

Advantage of an international system.

33. The advantage of a uniform system of tonnage measurement for all nations is so evident that it need scarcely be insisted on. Nevertheless, the negotiations to bring about so desirable a result have lasted for many years, and only after long and patient discussion have they resulted in the present approximation to uniformity of practice. The requirements of the Danube Commission and the difficulties with the Suez Canal Co. gave an impetus to these negotiations, and in 1873 an international tonnage commission assembled at Constantinople, on the invitation of His Imperial Majesty the Sultan, and comprised representatives of Germany, Austria-Hungary, Belgium, Spain, France, Great Britain, Greece, Italy, Holland, Russia, Sweden, Norway, and Turkey. At this commission rules were made for a common system of tonnage for vessels of all nations. These rules, having been adopted by Turkey, became obligatory on the Suez Canal Co. Such countries as did not at once make them their own law issued to their vessels special certificates of tonnage for the Suez Canal.

International Tonnage Commission at Constantinople in 1873.

The following passage from the report of the International Tonnage Commission states that—

> Unification of tonnage may be realized by adopting a formula combining the three following conditions, viz:
>
> 1. That of causing the internal capacity of a ship to be measured with all the precision that geometrical science is practically capable of.
>
> 2. That of expressing this capacity in tons the unit of which is obtained by a common divisor which best embodies for all maritime countries the ancient traditions of their common experience and which gives as quotient a mean of all the varying conditions under which ships are employed.
>
> 3. That of disallowing, in determining the net tonnage which is to be the basis of taxation, any other deduction of space but that which can not be used for earning freight by being employed for carrying passengers or merchandise.
>
> The commission has considered whether it would not be better to suppress the name of "ton of measurement" in order to avoid the continual confusion between this ton and the different tons of weight or volume employed in trade, but after patient deliberation it has formed the opinion that the time has not yet come when such a change in the usages of the commercial and maritime world can be recommended, and it has been decided to adopt as unit of measurement the ton of capacity of Moorsom's system, viz, of 100 English cubic feet, or 2.83 cubic meters.
>
> The international commission, after laying down these principles, acknowledged that the process of measuring the capacity of ships established in the United Kingdom by the Merchant Shipping Act of 1854, under the name of Moorsom's system, realizes best the conditions required to determine gross tonnage and agreed that no other system can better secure the application of the precise rules of deduction which are to determine the net tonnage nor lend itself with greater advantage to the unification of tonnage at which the commission is seeking to arrive.

Appendix No. 1, inclosure A, in No. 17.

We annex the full report[1] of the commission, and it is only necessary for us now to remark that, as follows from the above extract, the present law in this country was adopted, viz, roomage or internal cubical capacity, but with the modification that all spaces that could be readily closed in on the uppermost deck should be measured into gross tonnage, and in addition to deductions on account of crew space, deductions should further be made in respect of spaces necessary for purposes of navigation.

In respect of deduction for propelling space, two alternative rules were adopted:

(1) The actual contents of engine and boiler room plus 75 per cent thereof for screw steamers and 50 per cent for paddle steamers.

[1] See Appendix X to this report, p. 383.

(2) The actual contents of engine and boiler space and permanent bunkers; with the proviso that this deduction should not exceed 50 per cent of the gross tonnage, except in the case of tugboats.

Commissioners must determine what is the best practicable system.

34. Keeping in view all these considerations, it is clear that we have to determine not only what might be the best system for measuring tonnage, but what under existing circumstances is the best practicable system; and the advocates of any radical change have to show not only that the system they propose is in itself greatly superior to the existing system, but that it is capable of easy practical application.

Objects to be attained by any system.

35. The following seem to us to be the paramount objects to be attained by any system for admeasurement of tonnage:

(1) Just principles of taxation as between those who pay and those who receive dues on shipping.

(2) Fairness as between the different classes of ships in respect of which such dues are paid.

(3) The probability of its adoption in its entirety by the Governments of foreign countries.

(4) That no encouragement be given to the construction of faulty or unseaworthy ships.

Systems of tonnage discussed.

36. Considering the great complexity of the subject, there is probably no conceivable system which would attain these objects with absolute perfection,

None free from anomalies.

nor which would be entirely free from anomalies and practical difficulties. We readily admit that the measurement of the internal cubical capacity, with a gross and register tonnage, is not an absolutely perfect system, and that under its operation some anomalies and inequalities exist, all of which can not be completely removed. We further concede that in a plan by which the tonnage

Gross and register tonnage.

should be based on dead weight carrying, pure and simple, or on the displacement of the ship, either between the light and load lines, or below the load line only, or on the time and dock space occupied by the ship, there is an apparent simplicity which, whatever other questions might arise, commends itself, at first sight, to very favorable consideration. The complicated questions as to water-ballast double-bottom spaces, as to the admeasurement of awning decks and other superstructures above the line of immersion, and as to the deductions for propelling power would be avoided, and if all ships were designed and used for the carriage of dead-weight cargoes, a system founded on the capacity for carrying dead weight would undoubtedly give equality of treatment as between ship and ship.

Dead-weight basis would operate unequally.

37. But a dead-weight or a displacement basis for tonnage would, it appears to us, operate so unequally in respect of ships engaged in the conveyance of passengers and of light and valuable cargoes as to produce anomalies even greater than those at present complained of.

A cargo steamer with a displacement of 1,000 tons between her light and load lines would possess a tonnage and contribute to dues and charges to an extent ten times greater than a passenger steamer of similar dimensions with a displacement of only 100 tons and which might not only be the more valuable, but the more profitable of the two vessels. Gradations would exist between the two extremes just instanced in respect to ships engaged in conveyance of metals and heavy grain and those trading with ports where cotton, tea, wood, and other light freight are the staple articles of export.

Difficulty in rectifying inequality by a load line.

38. It is urged that this inequality might be rectified by a load line on all ships, based on their utmost dead-weight carrying capacity consistent with safety under the most favorable circumstances; but this suggestion would not meet the difficulty in respect to ships designed to sail on a fixed draft. To resort to

this scheme of placing a load line to be employed solely for the purpose of giving a tonnage for taxation would, it seems to us, only introduce a new, useless, and vexatious complication, as no passenger ship would ever be loaded to that point.

It has been further suggested that a proportion of space in the hull above the load line should be added to the displacement tonnage in respect of ships engaged in the passenger or light cargo trades, but this is open to the objection that it would call into operation two distinct principles in assessing the tonnage of one ship.

Dead-weight tonnage based on authoritative load line.

39. A dead-weight or a displacement tonnage based on a load line necessitates the fixing, by authority, and for this purpose only, of such a line upon the 39,000 vessels which constitute the mercantile marine of the British Empire, inasmuch as we conceive that it would be manifestly objectionable that an owner should virtually assess the tonnage of his ship by permitting him to fix his own load line for that purpose. In short, such a system would introduce into what is now a pure question of tonnage all the varied considerations as to seaworthiness and safety that can possibly arise concerning the build, form, equipment, loading, and employment of ships, points on which there are grave differences of opinion in this country, and on which it would be impossible to expect acquiescence or unanimity amongst foreign Governments.

Compulsory load line relates to "safety;" not to "tonnage."

The question as to whether a compulsory load line fixed by authority is desirable or practicable involves weighty considerations both of principle and of detail. It is not directly referred to us by Your Majesty's warrant, and we therefore have not deemed ourselves authorized to do more than to elicit opinions thereon in connection with tonnage from some of the persons who have tendered themselves for examination. We, however, are of opinion that if adopted at all such a load line should be dealt with in reference to what is its real object, viz, safety. It should not be mixed up with a question of tonnage.

Gross tonnage as basis of taxation considered.

40. The suggestion that dues should be paid on gross tonnage arrived at as at present, with a reduction of rate in favor of steamers, would not solve the difficulties arising out of the present system. What that reduction should be would raise a difficult subject of controversy, and there would still remain the questions as to the treatment of water-ballast double bottoms and of awning-deck and other erections, and a virtual deduction for propelling space would have to be made, though in another form, involving a remodeling of all dock, harbor, Suez Canal, and Danube dues.

Suggestion that tonnage is unnecessary and other basis of taxation substituted.

41. There remains to be considered the suggestion that a tonnage for ships is unnecessary, and that payment of dues and charges should be based on the dimensions of a ship (in the opinion of some persons the length and breadth only, and in that of others with the addition of depth also), and the time during which she occupies the water and quay accommodation.

The reply of dock authorities and others is that such a system would be an uncertain, complicated, and troublesome one to all parties concerned; that the accommodation required and afforded varies in respect to classes of ships and cargoes; that facilities for rapid discharge necessitate costly appliances, and are highly valued and readily paid for, in addition to ordinary dock rates, by ships under special circumstances; and, finally, that as quickness of discharge is more especially desired in respect to the most valuable ships and cargoes, payment by time would greatly favor one class of ship to the disadvantage of others less valuable.

Principle on which tonnage is, at present, ascertained, affirmed by commissioners.

42. After carefully weighing all the considerations surrounding this complex and difficult subject, and having special regard to the following facts:

First. That the 39,000 ships, of all descriptions and size, constituting the British mercantile marine are now admeasured under a system

based on internal cubical capacity, with deductions for crew and propelling space, and that the mercantile and shipping community are familiar therewith and base their transactions thereon;

Second. That all the chief maritime countries of Europe, the United States, the Suez Canal Co., and the Danubian Commission have adopted our system, and that it is very desirable for statistical purposes and uniformity of taxation that an international tonnage should be established;

Third. That the dues levied in British and many foreign ports, and by the commissioners of lights, are on our present tonnage, and that great confusion, expense, and difficulty would arise on their adjustment to any other system;

Fourth. That many important financial engagements are based on dues levied under the present system;

Fifth. That anomalies and inequalities would exist in any alternative scheme that has been suggested to us; and

Lastly. That one of the merits claimed for those alternative systems is that they practically arrive at the present tonnage by other means;

we have come to the conclusion that we can not recommend a change in the law which would affect the principle on which tonnage is ascertained, viz, the contents of the internal capacity of a ship represented by a roomage or space ton of 100 cubic feet, with deductions for propelling space.

Present law requires amendment in several particulars.

43. We, however, are of opinion that the law is defective, and requires to be amended in several particulars, and we report that its principle is not fully and properly carried into effect; that the terms of the rules require amendment, so as to make them suitable to the present state of shipbuilding; and that in certain particulars, to which we proceed to call attention, it is not altogether fair in its operation as between those who pay and those who receive dues on shipping, and as between the different classes of those who pay such dues.

Recommendations.

44. To carry into effect these conclusions we recommend—

Rules for admeasurement now in force to be amended.

(*a*) That the rules for admeasurement now in force should be amended so as to give greater freedom to the authority charged with the duty of carrying them into effect and to insure the utmost accuracy in ascertaining the contents of spaces.

Rules framed suitable to iron vessels.

(*b*) That special rules, suitable to the present state of shipbuilding, be framed for the admeasurement of iron vessels.

Depth for measurement of iron ships.

(*c*) That the depth for the measurement of tonnage of iron ships should be from the tonnage deck to the top of the floor plates, subject to a limitation as to the depth of the floor plates to be allowed in the measurement. In fixing this limitation regard should be had to the breadth as well as to the depth of the ship. We append a list of vessels at present registered having a bracket or cellular double bottom, showing the proportion which the depth of the double bottom bears to the breadth and depth of the ship; which, taken in connection with established practice as to depth of floor plates in vessels of various types, will furnish data on which equitable detailed rules can be framed for the purposes of legislation.

What gross tonnage should include.

(*d*) That gross tonnage should be made to include all permanently covered and closed-in spaces above the uppermost deck; and that erections with openings either on deck, or coverings, or partitions that can readily be closed in, should also be included in gross tonnage, but that skylights of saloons booby hatches for the crew, light and air spaces for the boiler and engine rooms when

situated above the uppermost deck, as well as erections for the purposes of shelter, such as turtle-backs, open at one end, and light decks supported on pillars and uninclosed, should not be measured for the purpose of their contents forming part either of the gross or register tonnage. Cargo carried under such erections should continue to be measured for dues under the act of 1876, the same as if stowed on the open deck.

How register tonnage should be arrived at.

(*e*) That for the purpose of arriving at a register tonnage that shall, as nearly as is practicable, represent the actual space in a ship available for cargo, there should be added to the deduction at present made for crew space the contents of the master's cabin, provided it be used solely by the master and crew; and, further, that there be deducted the contents of spaces used for the working of the helm, the capstan, the anchor gear, and for keeping the charts, signals, and other instruments of navigation and boatswain's stores, and also the spaces occupied by donkey engine and boiler if connected with the main pumps of the ship.

Further allowance to sailing vessels for sail-room space.

(*f*) That sailing vessels be further allowed a deduction for the space occupied by the sail rooms, this deduction not to exceed $2\frac{1}{2}$ per cent on the gross tonnage.

Deduction for propelling space in st amers.

(*g*) That the deduction for propelling space in steamers should be the actual space set apart by the owner, at his discretion, for the engine and boiler room and permanent bunkers, provided that such space be inclosed and separated from the hold of the ship by permanent bulkheads, and that the bunkers be so constructed that no access can be obtained thereto otherwise than through the ordinary coal chutes on deck, or in the ship's side, or from the openings in the engine room or stoke hold; but that to meet the varying requirements as to fuel of steamers engaged in long voyages, and to encourage ample ventilation to boiler and engine rooms in hot climates, owners of steamers should have the option to claim as deduction for propelling space the actual contents of engine and boiler space plus 75 per cent thereon in the case of screw steamers and 50 per cent in the case of paddle steamers, without restriction as to extent, construction, and use of bunkers: *Provided always,* That the deduction for propelling space shall not exceed 33 per cent of the gross tonnage of any screw steamer and shall not exceed 50 per cent of the gross tonnage of any paddle steamer.

Contents of spaces not first included in gross tonnage not to be deducted.

(*h*) That there shall not be deducted from the gross tonnage the contents of any spaces that have not first been included therein.

Certain spaces above uppermost deck to be specified in certificate of registry.

(*i*) That the spaces above the uppermost deck that are measured into gross tonnage should be specified with their contents on the certificate of registry of British ships and that the spaces whose contents are deducted from gross tonnage should in like manner be specified on the certificate of registry; and, further, that the carrying of passengers and cargo (including live stock) in spaces deducted from gross tonnage be prohibited under penalties except under the second rule for deduction of propelling space.

Carriage of passengers and cargo in deducted spaces to be prohibited.

Water ballast.

45. As regards provision for water ballast it seems to us that although double-bottom spaces may not be used for the stowage of cargo they often practically contribute to freight earning, inasmuch as the entire hold in such cases is available for light cargo, whereas a portion of the hold in a ship not fitted with water ballast would be unremuneratively occupied by stone or other material for ballast. It is also manifest that a ship fitted with a double bottom on the bracket or cellular system is externally a larger ship and is capable of carrying more dead-weight cargo, with a given freeboard, than a ship of the same internal dimensions and of precisely the same tonnage, con-

structed without a double bottom, or with double-bottom water ballast on the McIntyre system. It is, therefore, our opinion, notwithstanding the statements referred to in section 19 of this report, that whilst, on the one hand, ships constructed to carry water as ballast should not have undue advantage in the admeasurement of tonnage over ships carrying other sorts of ballast; on the other hand, they should not be placed at a disadvantage. We would leave owners at liberty to make such water-ballast arrangements as they please in each case, but we do not think that any water-ballast spaces which may be situated above the floor plates, or above the point indicated by the limitation as to the depth of the floor plates, should be exempted from measurement into tonnage.

Board of trade should have power to modify details of admeasurement.

46. The determination of all the details of tonnage admeasurement by acts of Parliament, without possibility of modification, seems to us in some degree to hinder the free development of naval construction, and it would be for the advantage of the mercantile marine if the board of trade were empowered to modify these details to meet special and unforeseen alterations in the designs of ships, a return of such modifications to be laid upon the table of the House of Commons within 40 days of their introduction or of the sitting of the House.

Legislation not to be made retrospective.

47. We are of opinion that legislation to carry into effect these recommendations should not be retrospective in its operation.

All which we humbly submit to Your Majesty's gracious consideration.

C. M. Norwood. Robert Capper.
J. Stokes. T. D. Hornby.
E. J. Reed. Wm. Pearce.
Thomas Gray. T. B. Royden.
James P. Corry.

J. Edward Wilkins, *Secretary.*

August 25, 1881.

APPENDIX XIX.

LAW, RULES, AND REGULATIONS FOR THE GOVERNMENT OF ST. MARYS FALLS CANAL.

APPENDIX XIX.

LAW, RULES, AND REGULATIONS FOR THE GOVERNMENT OF ST. MARYS FALLS CANAL, MICH.

The Law.

[Extract from act of Congress, Aug. 17, 1894.]

Sec. 4. That it shall be the duty of the Secretary of War to prescribe such rules and regulations for the use, administration, and navigation of any or all canals and similar works of navigation that now are, or that hereafter may be, owned, operated, or maintained by the United States as in his judgment the public necessity may require.

Such rules and regulations shall be posted in conspicuous and appropriate places, for the information of the public, and every person and every corporation which shall knowingly and willfully violate such rules and regulations shall be deemed guilty of a misdemeanor, and on conviction thereof in any district court in the United States within whose territorial jurisdiction such offense may have been committed shall be punished by a fine not exceeding five hundred dollars, or by imprisonment (in the case of a natural person) not exceeding six months, in the discretion of the court.

Rules and Regulations.

ADMINISTRATION.

1. The canal and all its appurtenances shall be in charge of the officer of the Corps of Engineers, United States Army, detailed for that duty by the Secretary of War. His representative at the locality shall be the assistant engineer in local charge of the works of river and harbor improvement, who, for canal purposes, shall be styled general superintendent. Except in case of emergency all orders and instructions from the engineer officer in charge shall be communicated to the canal force through the general superintendent. In case of emergency, however, he is authorized to take such steps as may be immediately necessary without waiting for instructions from the engineer officer in charge.

2. The canal force shall consist of one superintendent, one clerk, three assistant superintendents, and such engineers, watchmen, foremen, lockmen, and laborers as may be necessary to the efficient operation of the canal and care of grounds and other public property pertaining to the canal.

3. The superintendent shall be charged with the immediate control and management of the entire force. He shall see that all members perform their respective duties, and that all rules and regulations for use of the canal and grounds are duly enforced, to which end he is authorized to give all necessary orders and directions in accordance with said rules and regulations, both to employees of the Government and to any or every person within the limits of the canal or the grounds pertaining thereto, whether navigating the canal or not. In case of his absence or disability his duties shall be performed on their respective watches by the assistant superintendents.

4. The clerk shall keep the books and records pertaining to the canal and grounds. He shall see to the collections of all required statistical information relating to the business of the canal. He shall prepare all vouchers and perform all other duties that may arise of a similar character.

5. The remainder of the canal force shall be divided into three watches, each consisting of one assistant superintendent and the necessary enginemen, watchmen, foremen, lockmen, and laborers. The duration of each watch shall be eight hours, and the watches shall be kept in rotation, but in case of emergency the superintendent may vary the duration of the watches, the ordinary routine to be resumed as soon as the emergency has passed.

6. Under the personal direction of its assistant superintendent the individual members of each watch during its tour of duty will be employed in passing vessels through the canal, in the care and protection of the canal and grounds, as well as of all other property belonging to the United States. They are enjoined to be diligent and attentive in the performance of their duties, courteous but firm to all with whom they come in contact, and to never lose sight of the fact that the purpose of their employment is to facilitate the use of the canal.

USE AND NAVIGATION OF THE CANAL.

7. The "canal grounds" when used in these rules will mean all of these grounds which have been set aside for the use of the canal or occupied in its construction and including the area covered by its riparian rights: Therefore the western limit is the end of the pier on which the lighthouse stands, and the eastern limit is the northeastern corner of Old Fort Brady Reservation. The "canal" is the water lying between these two points and the bed and banks containing the same.

8. The movement of all vessels, boats, or other floating things in the canal shall be under the direction of the superintendent and his assistants, whose orders and instructions must be obeyed.

9. All steamers desiring to use the locks shall signal for the same by two long and two short blasts of the whistle.

10. No tow shall enter or pass through the canal with a towline more than 400 feet in length.

11. In passing the canal vessels or boats belonging to the United States Government shall have precedence over all others. All registered merchant vessels must pass through the canal and locks in the order of their arrival at the canal, unless otherwise directed by the superintendent or his assistant in charge. The time of arrival at the canal will be the time of crossing the straight lines which join the extremes of the piers at the eastern and western ends of the canal, respectively. Unregistered craft will not be locked separately unless specially permitted by the superintendent or by one of the assistant superintendents of the canal.

12. No person in charge of a boat coming from above shall bring it within 400 feet of the upper gates until they are made ready for it to enter, and no person in charge of a boat coming from below shall bring it within 200 feet of the lower gates until they are ready for entrance.

13. Upon each passage through the canal masters or clerks of vessels or boats shall report to the canal office, upon prescribed forms, a statement of passengers, freight, and registered tonnage, and such other statistical information as may be required by the blank forms which are issued to them for the purpose.

14. No business, trading, or landing of freight or baggage will be allowed on or over the canal piers or lock walls, nor over the piers or grounds forming a part of the canal or its appurtenances, except such small articles as may be readily carried in the hand. All persons in charge of or employed on any ferryboat are prohibited landing such boat at any of the canal piers.

15. No person in charge of or employed on any vessel or boat shall moor it to the piers except when specially permitted by the superintendent, and then only in such places and for such times as he may direct.

16. No person shall throw any material of any kind into the canal, nor shall any person clean flues in the locks.

17. All persons, whether in charge of vessels or not, are prohibited from willfully or carelessly damaging the canal grounds, the canal, or any part thereof.

18. No person shall enter or navigate the canal with a boat which when entering, or while navigating the canal, shall have an iron or irons projecting from it or rough surface or surfaces on it which would be liable to damage the lock walls or canal piers.

19. No person shall cause or permit any vessel or boat of which he is in charge, or on which he is employed, to in any way obstruct the canal or delay in passing through it, unless he is permitted to do so by the superintendent or one of the assistant superintendents of the canal.

20. In case of any vessel, boat, or other craft or raft sinking or grounding in the canal or otherwise obstructing it the general superintendent, or in his absence the superintendent of the canal or the assistant superintendent for the time being, acting as superintendent, shall have the right to take possession of such vessel, boat, or other craft or raft, as shall be necessary for the purpose, and remove it and clear the canal of the obstruction caused by it, and no one shall interfere with or prohibit him from doing so or do anything that will tend to interfere with or prohibit him from doing so.

21. On the canal being obstructed by a vessel or boat or other craft, or a raft, by sinking, grounding, or otherwise, the general superintendent of the canal, the superintendent, or one of the assistant superintendents, in the contingency and in the sequence named in the preceding paragraph, may give notice in writing.

The foregoing rules and regulations for the government of St. Mary's Falls Canal, Mich., shall be of force and effect upon the opening of navigation for the season of 1895.[1]

DANIEL S. LAMONT, *Secretary of War.*

[1] These rules were in force unamended in 1912.

APPENDIX XX.

REGULATIONS PRESCRIBED BY THE SECRETARY OF WAR FOR THE USE, ADMINISTRATION, AND NAVIGATION OF THE LOUISVILLE AND PORTLAND CANAL.

Appendix XX.

UNITED STATES REGULATIONS PRESCRIBED BY THE SECRETARY OF WAR FOR THE USE, ADMINISTRATION, AND NAVIGATION OF THE LOUISVILLE AND PORTLAND CANAL.[1]

AUTHORITY AND PENALTIES.

The river and harbor act of August 18, 1894, contains the following sections:

"Sec. 4. That it shall be the duty of the Secretary of War to prescribe such rules and regulations for the use, administration, and navigation of any or all canals and similar works of navigation that now are or that hereafter may be owned, operated, or maintained by the United States as in his judgment the public necessity may require.

"Such rules and regulations shall be posted, in conspicuous and appropriate places, for the information of the public; and every person and every corporation which shall knowingly and wilfully violate such rules and regulations shall be deemed guilty of a misdemeanor and, on conviction thereof in any district court of the United States within whose territorial jurisdiction such offense may have been committed, shall be punished by a fine not exceeding five hundred dollars, or by imprisonment (in the case of a natural person) not exceeding six months, in the discretion of the court."

1. *Authority of canal officers.*—The movement of all boats and floating craft of every kind, while in the canal, shall be strictly governed by the orders of the canal officers.

2. *Entrance to canal.*—No boat or floating craft shall enter the canal from either direction without permission. In case two or more boats or tows wish to enter at the same time, their order of entry shall be determined by the superintendent of the canal, or his authorized agent.

3. *Draft of boats.*—No boat, barge, or vessel of any kind shall enter the canal drawing more water than is shown by the canal gauges.

4. *Handling of tows.*—Tows must be strung out no more than three wide for passage through the canal before entering. While thus engaged in preparing for passage they must always leave room for packets to enter or leave the canal. The size of a single tow must in no case exceed the following:

(1) Twelve coal boats and four fuel boats.

(2) Ten model barges and four fuel boats.

(3) Twenty square barges.

5. *Boats meeting in canal.*—Boats meeting in the canal shall pass to starboard; if unable to pass in the canal proper, the boat nearest to a turn-out basin shall take it; in case of doubt, the ascending boat shall enter the basin.

6. *Management of boats in canal.*—No boat shall attempt to run ahead of another while in the canal. The boat that enters first shall have precedence, except as provided hereinafter.

7. *Unnecessary delay in canal.*—Boats or barges must not obstruct navigation by unnecessary delay in entering or passing through the canal or the locks. After passing through the locks, ascending barges must be so arranged in the basin as to leave the passage clear; descending barges, as soon as locked through, must be removed to some point below the lower end of the guiding wall. Masters and pilots will be held to a strict accountability that the approaches to the locks are not at any time obstructed by barges that have passed through.

8. *Station while waiting for lockage.*—Descending boats and tows will wait for lockage in the basin above the locks; ascending boats and tows, waiting for the new locks, will remain below the lower end of the guiding wall. In all cases a free passage to and from the locks must be left.

[1] Rules of Oct. 12, 1894, as amended Sept. 16, 1898 and Feb. 21, 1911.

9. Signals.—Boats will signal for drawbridges by three short and distinct whistles; for locks by four similar whistles.

10. Precedence at locks.—Ordinarily, the boat arriving first at a lock will be the first to be locked through; but where many boats are to be passed, precedence shall be given, firstly, to boats belonging to the United States, and, secondly, to boats carrying the United States mail. Passenger boats shall also have precedence over tows, and loaded tows over empty ones.

11. Loss of turn.—Boats that fail to enter a lock with reasonable promptness, after being authorized to do so, shall lose their turn.

12. Moorings in locks.—Steamboats when in the locks shall be moored by bow and stern lines to the snubbing posts provided for that purpose.

13. Protection of lock gates.—Boats will not be permitted to enter or leave the locks until the lock gates are fully in the gate recesses, and the lockmaster has ordered the boat to start.

14. Use of canal as ice harbor.—Boats will be permitted to use the canal as an ice harbor whenever danger from ice is imminent, but all such craft must leave the canal as soon as navigation is resumed.

15. Commercial statistics.—Masters or clerks of boats shall furnish in writing to the superintendent of the canal such statistics of passengers and cargo as may be required.

16. Handling gates.—No one not employed by the United States for that purpose will be allowed to move any gate or valve belonging to the canal.

17. Damages to walls or fixtures.—The sides of all craft passing through the canal must be free from projections of any kind that might injure the walls. Steamboats must be provided with suitable fenders.

18. Refuse in canal.—The placing of any ashes, refuse, or obstruction in the canal, or in the locks, or on the walls thereof, is prohibited.

19. Trespass on canal property.—Trespass on canal property, or injury to the canal banks, locks, fences, trees, houses, shops, or any other property of the United States pertaining to the canal, is strictly forbidden.

20. Sunken or wrecked boats, vessels, craft, etc.—In case of any boat, vessel, or other craft, or raft sinking or grounding in the canal, or otherwise obstructing it, the officer, or agent, of the United States in charge of the canal, shall have the right to take such possession of such vessel, boat, or other craft, or raft, as shall be necessary for the purpose, and remove it, and clear the canal of the obstruction caused by it, and no one shall interfere with or prohibit him from doing so; or do anything that will tend to interfere with or prohibit him from doing so: *Provided,* That the officer or agent of the United States may, in his discretion, give notice in writing to the owners of any vessel, boat, or other craft, or raft, obstructing the canal as aforesaid.

21. Fishing from dams or appurtenant structures.—No person shall fish from the dams or appurtenant structures without proper authority from the officer or agent in charge, nor use such structures in connection with any mode of fishing that may be forbidden by the laws of the State of Kentucky.

APPENDIX XXI.

OPERATING RULES AND NAVIGATION CHARGES OF THE SUEZ MARITIME CANAL, JANUARY, 1913.

APPENDIX XXI.

OPERATING RULES AND NAVIGATION CHARGES OF THE SUEZ MARITIME CANAL, JANUARY, 1913.

[Extract from the act of concession dated 5th January, 1856.]

ARTICLE 14.

"We hereby solemnly declare for ourselves, and for our successors under reserve of ratification by H. I. M. the Sultan, the great maritime canal from Suez to Pelusium and ports belonging to it henceforth and forever open, as neutral passages to any merchant vessel crossing from sea to sea without any distinction, exclusion, or preference whatever for persons or nationalities, against the payment of dues and execution of regulations established by the said universal company grantee for the working of the said canal and its dependencies.

ARTICLE 17.

"To indemnify the company for the expenses of construction, maintenance, and working devolving upon them by these presents, we authorize the company henceforth, and during the whole term of their lease as determined by clauses 1 and 3 of the preceding article, to establish and levy for the passage through the canals and ports thereunto appertaining navigation, pilotage, towage, tracking, or berthing dues according to tariffs which they shall be at liberty to modify at all times upon the following express conditions:

"1st. That these dues be collected without exception or favor from all ships under like conditions.

"2nd. That the tariffs be published three months before they come into force, in the capitals and principal commercial ports of all nations whom they may concern.

"3rd. That for the special navigation due the maximum toll shall not exceed 10 francs per ton of capacity on vessels and per head of passenger."

RULES OF NAVIGATION.

GENERAL.

ARTICLE 1.

OBLIGATION TO COMPLY WITH THE REGULATIONS.

SECTION 1. Transit through the Suez Canal is open to ships of all nations, subject to their complying with the conditions hereinafter stated.

On receiving a copy of these regulations, captains of ships bind themselves to abide by and conform with them in all points, to comply with any requisition made in view of their due carrying out, and obey all signals prescribed in the special book of signals, of which a copy is placed at their disposal.[1]

SEC. 2. Mail steamers, ships carrying petroleum in bulk, or notified as having explosives on board, and ships under quarantine, must show the signals prescribed in the special book of signals.[1]

SEC. 3. Ships carrying petroleum in bulk must comply with these regulations and also with special regulations, a copy of which is given to captains on their arrival in one of the canal ports.

SEC. 4. The navigation of undecked vessels is governed by special regulations, a copy of which is handed to the masters before entering the canal.

[1] See page 514 for the particulars of roads and harbor pilot signals.

Article 2.

DRAFT OF WATER. PROPER TRIM OF THE SHIP.

The maximum draft of water authorized is at present 8 meters 53 centimeters (28 feet English).

Ships are not permitted to transit until it has been ascertained by the company's officials that their draft of water does not exceed the maximum and that they are well found in every respect for navigation in the canal.

Article 3.

THE RESPONSIBILITY OF CAPTAINS. THE PILOT'S FUNCTIONS.

All ships measuring more than 100 tons gross must take, either for entering or leaving the harbors of Port Said and Port Thewfik, or for transit through the canal, a pilot of the company, who will furnish all particulars as to the course to be steered.

Captains are held responsible for all groundings or accidents of whatsoever kind resulting from the navigating or handling of their ships by day or by night.

The pilots place at the disposal of the captains their experience and practical knowledge of the canal, but as they can not be acquainted with the defects and peculiarities of individual steamers and their machinery whether in navigating, stopping, steering, etc., the responsibility of handling the ship devolves solely upon the captain.

The functions of pilots commence, or cease, at the exterior buoys of Port Said and Port Thewfik Harbors.

Article 4.

MAIL SHIPS. DISTINCTIVE CHARACTER.

Mail steamers are all steamers performing a regular mail service under contract with a Government, at fixed dates appointed in advance. The contract must have been duly exhibited to the company by the owners.

Article 5.

SHIPS IN BALLAST. DISTINCTIVE CHARACTER.

Ships are considered as being in ballast when they carry no passengers, no mails, and do not carry either coals or merchandise of any description in whatever quantity, except bunker coal or fuel.

In order to be entitled to claim the ballast rate,[1] the volume of the bunker coal or fuel must not exceed in volume the allowance specified on the special certificate as the deduction for bunker space.[2]

TONNAGE AND DUES.

Article 6.

SUEZ CANAL TONNAGE.

Section 1. The tonnage on which all dues and charges to be paid by ships, as specified in these regulations, are assessed, is the net tonnage resulting from the system of measurement laid down by the International Commission held at Constantinople in 1873,[3] and duly entered on the special certificates issued by the competent authorities in each country.

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[1] See art. 7.

[2] See arts. 16 and 17 of the regulations for the measurement of tonnage. Bunker coal or fuel should, primarily, be contained in the ship's fixed or movable bunkers. It may, in certain cases, on application by the captain, be stowed on deck or in the ship's holds, provided the total quantity carried can be easily ascertained.

[3] See Appendix XII, pp. 411–412. Regulations for the Measurement of Tonnage.—Additional deductions allowed by the Suez Canal Company and rules for the measurement of deck spaces.

In assessing the dues, any alteration of net tonnage subsequent to the delivery of the above-mentioned certificates is taken into account.

SEC. 2. The company's officials are empowered to ascertain whether cargo or passengers are carried in any space not included in the net tonnage entered on the ship's special certificate; and, generally may verify whether all spaces which ought to be included in the tonnage are entered on the certificate and are correctly determined therein.

SEC. 3. Every ship not provided with the special certificate showing the net tonnage prescribed by the Constantinople Commission, is measured by the company's officials in conformity with the rules laid down by the Constantinople Commission.

The net tonnage thus arrived at is provisionally availed of for the assessing of the dues until such time as the ship tenders a special certificate duly drawn up by the competent authorities.

ARTICLE 7.

TRANSIT DUES.

SECTION 1. The rate of tonnage dues is, at present, 6 francs 25 centimes per ton.

SEC. 2. Ships in ballast are allowed a reduction of 2 francs 50 centimes per ton on the full rate.[1]

ARTICLE 8.

PASSENGER DUES.

SECTION 1. In addition to the tonnage dues mentioned in article 7, transit dues are charged on all passengers at the rate of 10 francs per passenger above 12 years of age, and 5 francs per passenger between 3 and 12.

Children under 3 years of age pay no dues.

SEC. 2. Sailors occasionally taken on board of ships passing through the Suez Canal are considered as passengers and are charged for as such, unless they are duly entered on the ship's muster roll and certified as being intended for ships belonging to the same owners.

ARTICLE 9.

BERTHING DUES.

The rate of berthing dues at Port Said, Ismailia and off the company's embankment at Port Thewfik, is 2 centimes per ton, per day, whatever be the duration of the ship's stay, but the first 24 hours are not included. These dues are payable every 10 days.

ARTICLE 10.

PILOTAGE DUES.

Pilotage in the canal itself is free of charge.

The payment of dues for pilotage in or out of Port Said is compulsory on all ships above 100 tons gross measurement.[2]

Pilotage in or out of the harbor is charged for as follows:

1. For ships not going through the canal: By day, steamers, 25 francs; sailing vessels, 10 francs. By night (between sunset and sunrise), steamers, 50 francs; sailing vessels, 20 francs.

2. For ships going through the canal: By day, free. By night, steamers, 25 francs; sailing vessels, 10 francs.

Pilotage in or out of Port Thewfik, whether by day or by night, is not charged for.

When the pilot is kept on board beyond the time required for pilotage proper, a charge of 20 francs per day is due.

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[1] See art. 5.

[2] See art. 3.

ARTICLE 11.

HALF-TRANSIT.

A reduction of one-half of the tonnage and passenger dues is allowed to ships and passengers using the canal only as far as Ismailia, whether from Port Said or Port Thewfik, or inversely.

ARTICLE 12.

LOCAL TRAFFIC BETWEEN PORT SAID AND ISMAILIA.

The rate of tonnage dues charged to ships effecting a complete return journey between Ismailia and Port Said, one half in ballast and the other half with cargo, is 2 francs 60 centimes per ton, only, for the whole journey. Payment must be made previous to the commencement of the journey. Over and above this, the ships are subject to the same incidental charges as other ships.

ARTICLE 13.

MODE OF PAYMENT OF DUES.

SECTION 1. All charges, of whatever nature, prescribed in these regulations must be paid in cash. Payments may be tendered either at the company's offices in Egypt, at the head office in Paris, or to any duly appointed agent of the company.

SEC. 2. The tonnage dues and the passenger dues are payable in advance.

SEC. 3. In the case of amounts tendered otherwise than at the company's offices in the Isthmus, receipts are delivered to shipowners or their representatives, which the captain hands as cash to the company's officials in Egypt appointed to collect the dues.

In the case of payments tendered too late for receipts to be handed to the captain, the company wire out to their Port Said office, at owner's cost, due notice of the payment.

Whenever amounts thus paid in advance are insufficient for the discharge in full of all charges and incidental expenses due by the ship, the balance must be paid in Egypt at the company's offices.

SEC. 4. Claims for errors in the declaration of tonnage or in the levying of the dues must be sent in within a month after the ship's passage through the canal.

CONDITIONS OF TRANSIT.

ARTICLE 14.

FORMALITIES TO BE FULFILLED.

When a ship intending to proceed through the canal has taken her moorings, the captain must enter his ship at the transit office and pay the transit dues, as well as, when there is occasion, the dues for pilotage, towage, and berthing. A receipt is delivered to him, which serves as a voucher in case of need.

The following written information must be handed in by him:

Name and nationality of the ship, authenticated by exhibiting the ship's papers respective thereto.

Name of the captain.

Names of the owners and charterers.

Port of sailing.

Port of destination.

Draft of water.

Length.

Breadth.

Number of passengers as shown by the passenger list.

Statement of crew as shown by the ship's articles.

Capacity of the ship authenticated by producing her special certificate.

The captain must also exhibit his bill of health.

Article 15.

PREPARATIONS FOR ENTERING THE CANAL.

Section 1. All ships ready to enter the eanal must have their yards braeed forward, their ladders and jib booms run in, and their boats swung in.

Sec. 2. The hawsers required to tie up in the canal must be in readiness at suitable points on deek, and every arrangement made for their rapid handling.

A boat must be in eonstant readiness for lowering in order to carry the hawsers to the mooring posts without any delay.

Sec. 3. The bow anehors must be ready to let go.

The steering gear and the engine-room telegraph must be ascertained to be in good working order before entering the canal.

Sec. 4. Captains must, before entering the eanal, aseertain that deek loads, if any, are stowed in such manner as not to affeet the ship's stability or impede the erew.

Sec. 5. The eaptains of ships in ballast must fill all spaees intended to be used for earrying water ballast in sueh proportion as the offieials of the eompany may direct.

Sec. 6. Steamers intending to go through the canal by night [1] must first satisfy the offieials of the eompany in Port Said or Port Thewfik, that they are provided—

1. With an electrie projeetor (searchlight) showing the ehannel 1,200 meters ahead (roughly, 1,300 yards) and so construeted as to admit of rapid splitting up of the beam of rays into two separate segments of 5° each, with a dark seetor in the middle also of 5°.

2. With eleetric overhead lights powerful enough to light up a eircular area of about 200 meters diameter (roughly, 650 feet English) around the ship.

The offieials of the eompany decide whether the applianees fulfill the requirements of the regulations in order to insure safe navigation of the eanal at night.

Special insistanee will be exereised on care being taken that the escape of steam from the dynamo engine does not obstruet the light.

Night transit may be suspended in ease of damage to, or imperfection in, the electrieal appliances.

MOVEMENTS OF SHIPS—ACCIDENTS.

Article 16.

MOORING IN CANAL PORTS.

Ships take their moorings at Port Said or Port Thewfik at sueh berth as the officials of the company may direct.

Ships moored in the eanal ports must show by night the lights prescribed by Artiele II of the international regulations for preventing collisions at sea. Nevertheless, at Port Said, ships moored at right angles with the banks must earry the forward white light at the extreme bows, at a sufficient height for it to be elearly visible.

Article 17.

HOURS OF DEPARTURE AND MOVEMENTS UNDER WAY.

Section 1. The eompany preseribe the hour of departure of eaeh ship and all her movements in the canal in such manner as to give full security to navigation, as well as to insure as far as possible the rapid passage of mail steamers.

Consequently no ship ean demand as a right immediate passage through the eanal, neither will any claim be admitted in eonsequenee of any delay arising from the foregoing eauses.

Sec. 2. The captain must set a wateh both by day and by night.

Sec. 3. All steamships, tugs included, must stop whenever there is not a elear passage ahead.

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[1] See, regarding night transit, art. 19, pars. 2, 3, and 4.

They must also slow down in passing sidings, sections of the bank being stone-faced or cut back, as well as all ships in sidings or under way, hoppers, dredgers, and other floating plant.

SEC. 4. As soon as a ship has tied up, whether in or out of a siding, she must hoist the signals prescribed in the special book of signals.

Ships must slack down any hawsers they may have had to run across the canal so as to give free passage to tugs, steam launches, hopper barges, and any other light-draft craft that may have to pass them.

Men must be constantly at hand ready to slack down the hawsers or cut them in case of need. The ship's engines must always be under steam ready to be started.

SEC. 5. Ships proceeding in the same direction are not allowed to overtake one another under way in the canal.

In the case of a ship being allowed to pass another one ahead of her, this must be done conformably with the indications given by the company's officials.

SEC. 6. Captains are forbidden to anchor in the canal, except in case of absolute necessity.

ARTICLE 18.

SPEED.

The maximum speed of ships passing through the canal is fixed at 10 kilometers (5⅓ nautical miles) per hour.

Exceptionally, ships may be allowed to exceed the 10 kilometers maximum under the entire responsibility of captains.

ARTICLE 19.

NIGHT TRANSIT.

SECTION 1. Navigation of sailing craft of every description by night is entirely forbidden.

SEC. 2. During night transit ships must keep their electric projector alight.[1] They must show their regulation lights and keep a man on the lookout forward.

SEC. 3. When a ship under transit at night is about to tie up, whether in or out of a siding, she must at once extinguish her electric projector and turn on her electric overhead lights.[1] When she has completed tying up she must extinguish her electric overhead lights and her navigating lights and hoist the lights prescribed in the special book of signals.

SEC. 4. Ships navigating at night in the Large Bitter Lake must extinguish their electric projector except in the portions immediately adjoining the outlets of the canal into the lake where the channel continues to run between two lines of buoys.

SEC. 5. Ships not provided with electric light are only allowed to transit at night under exceptional circumstances, the captain being entirely responsible for any delay, mishap, or damage of any description that may happen to his own ship, as well as for any similar accidents he may cause to other ships in the canal or to the company's craft and plant. Ships going through the canal under these conditions are subject to all the other rules for night transit.

ARTICLE 20.

PROHIBITIONS.

The following prohibitions are hereby notified to captains:

1. Throwing overboard in the ports of the canal or at any point during transit from sea to sea earth, ashes, cinders, or articles of any kind.

2. Picking up, without the direct intervention of the company's officials, any object that may have fallen into the canal. Whenever any object whatsoever falls overboard, the circumstance must be immediately brought under the notice of the pilot, who is instructed to report same to the company's officials at the nearest station. The salvage, by whatever means,

[1] See art. 15, par. 6.

of articles that may have fallen overboard is always at the captain's charge. Articles shall be handed to him on payment of any such expense incurred.

3. Allowing any gunshots to be fired.

4. Sounding their steam whistle in the ports of the canal, except as an alarm signal in case of serious danger.

5. Burial in the banks of the canal.

Article 21.

ACCIDENTS.

Section 1. Whenever a collision appears probable, ships must not hesitate to run aground, should this be necessary to avoid it.

Sec. 2. Whenever a ship is accidentally stopped on her way, she must, if other ships are following her, attract their attention by sounding her steam whistle sharply four or five times in close succession, repeating this several times at a few moments' interval until the ship following her repeats this signal, which must be taken as an order to slacken speed at once with a view to stopping, if need be.

Ships stopped accidentally at night must immediately replace their white stern light by a red light.

In case of grounding the captain must also immediately signal to that effect conformably with the indications in the book of signals.

Sec. 3. When a ship gets aground, the officials of the company alone are empowered to prescribe and supervise all operations required to get her off, including unloading and towing if necessary, captains placing at their disposal all available means.

All attempts on the part of other ships to get off a ship aground are strictly prohibited.

Sec. 4. When a ship grounds or stops in the canal in consequence of an accident other than a collision, the company, in order to remove the obstruction in the fairway with all possible speed and to hasten the restarting of the ship, does not claim any reimbursement whatsoever of expenses incurred in getting off the ship or towing her, if necessary, as far as the next siding. If from such siding the ship continues her journey in tow, she must pay towage charges as scheduled in the present regulations.

It is moreover well understood that ships bear all expenses incurred in repairs, or putting into condition, necessary to remedy such damage as might interfere with their restarting, whatever be the moment at which the damage may have taken place, and that they remain responsible for all damage which may be the consequence of the grounding.

Sec. 5. When a ship grounds or stops in the roads, or ports, from whatever cause, or in the canal itself in consequence of collision, all charges of getting the ship off, towing, unloading, reloading, etc., are charged to the ship and must be paid, as per statement drawn up by the company, before leaving Port Thewfik or Port Said.

TOWAGE AND CONVOYING.

Article 22.

CASES WHERE TOWAGE IS COMPULSORY.

Towage is compulsory in the case of—

1. Sailing ships above 50 tons gross.

2. Any ship not considered by the officials of the company as fulfilling the conditions necessary for safe navigation.

3. Ships carrying in bulk any quantity whatever of petroleum having a flash point below 23° C. (73° F.).

In all cases other than the above ships may demand to be towed or convoyed through the canal, subject to the conditions hereinafter specified. In such cases towing, or convoying, is

not compulsory on the company, who undertake it only in so far as they have any tugboats disengaged.

Ships in tow transit by day only. They must supply their own towropes.

Article 23.

TOWAGE DUES IN THE CANAL.

Section 1. The charge for towage over the whole length of the canal is as follows:

1. When towage is compulsory (see art. 22):

For steamers, 50 centimes per ton, subject to keeping their engines going or in readiness; the maximum charge being 2,500 francs.

For steamers unable to give the assistance of their propelling power, or not desiring to do so, and for sailing ships above 400 tons, 1 franc per ton; the maximum charge being 5,000 francs.

2. When towage is not compulsory, but takes place at the captain's request:

For steamers using their engines or holding them in readiness, 1 franc per ton, 1,200 francs being a minimum charge.

For steamers not desiring to assist the tug with their propelling power, 2 francs per ton, 2,000 francs being a minimum charge.

Sec. 2. When a tug tows a ship one-half of the length of the canal only, one-half only of the dues above specified for towage over the whole length is charged.

No other division than one-half of the length of the canal is admitted in charging for towage, from Ismailia to Port Said being considered one-half, and from Ismalia to Port Thewfik the other half, or inversely.

Sec. 3. By way of exception to the above scale of charges, a rate or charge is fixed by private agreement for the towage, whether compulsory or optional, of lighters, dredgers, and floating appliances of any description. The towage charge for sailing ships of 400 tons or under, is likewise fixed by private agreement.

Article 24.

TOWAGE DUES IN THE ROADS.

The charge to ships applying for towage to or from the roads by the company's tugs is fixed at 10 centimes per ton; at Port Said, for the distance between the inner docks and the exterior buoys and conversely; at Port Thewfik, for the distance between the docks and the roads, and conversely, the minimum charge being 25 francs.

For towage over a greater distance the charge is fixed by private agreement.

Article 25.

DUES FOR CONVOYING.

Section 1. When a ship requires a tug to act as a tender, the charge for convoying is 1,200 francs per day if a tug of the first class be employed, and 800 francs per day for a tug of the second class. In the event of stoppages the tug renders assistance in getting the ship under way as often as may be necessary.

Sec. 2. When a ship is convoyed over one-half of the canal only the charge is only one-half of that stated above for the whole length of the canal.

Article 26.

HIRE OF TUGS.

In all other cases tug hire is invoiced at the tariff rates annexed to the present regulations.

Article 27.

USE OF PRIVATE TUGS.

Section 1. Shipowners are authorized to have their ships towed or convoyed by their own tugs, or tugs belonging to third parties, under their entire responsibility. Such tugs must be approved of by the canal company.

Sec. 2. Ships towed or convoyed by approved tugs pay 50 centimes towage dues per ton.

Sec. 3. Approved tugs towing or convoying ships belonging to their owners are free of any charge.

When they go through the canal either for the purpose of meeting ships of their owners which they are about to tow or convoy, or in order to return to their home berth after having towed or convoyed the said ships, tugs are not liable to payment of the tonnage dues, but they must take a pilot on board.

They must carry neither goods nor passengers; the fact of having on board passengers or goods renders them liable to the payment of all dues and charges to which ships in transit are subject.

Sec. 4. Approved tugs employed in towing or convoying ships not belonging to their owners pay the same dues and charges as ships in transit for every passage through the canal.

Sec. 5. Notwithstanding the special treatment above stipulated, tugs belonging to private owners are subject to the strict observance of all other articles of the regulations relative to ships under way or berthed.

TARIFF FOR THE HIRE OF PLANT.

		Francs.
A tugboat:		
First class	per hour	92
Second class	do	55
Third class	do	27
Fourth class	do	18
A lighter:		
First category	per day	37
Second category	do	19
Third category	do	12
A sheer hulk of 60 tons:		
First hour		60
For each consecutive hour after the first—		
At work		30
While shifting position or waiting in port		30
While shifting position or waiting out of port		15
A sheer hulk of 25 to 40 tons or a floating self-propelling crane of 12 tons:		
First hour		50
For each consecutive hour after the first—		
At work		25
While shifting position or waiting in port		25
While shifting position or waiting out of port		12.50
A sheer hulk of 8 tons:		
First hour		35
For each consecutive hour after the first—		
At work		17
While shifting position or waiting in port		17
While shifting position or waiting out of port		8.50
Greindl exhausting pump:		
Hire of whatever duration		500
Plus per hour of working		50
Plus per hour of waiting at rest		40
Ordinary lighter pump	per hour	15
Diving appliances:		
Hire	do	8
Plus, per hour of diving proper, reckoned from the moment the diver enters the water to the moment he leaves it		6.25

Note.—For tugboats, hire is reckoned from the time of first firing; for the other appliances, from the time they leave the depot. Hire ceases when they reenter the depot. The charges for towage of the appliances have to be paid over and above the amount for hire.

ROADS AND HARBOR PILOT SIGNALS.

1. Port Said.

SIGNALS TO BE MADE USE OF IN THE ROADS.

By day: Flag S of the International Code or national pilot flag.....Send me a pilot to enter the harbor.
By night: Lights hoisted at the foremast head followed by rockets or blue lights. Do.

SIGNALS TO BE MADE BY THE HARBOR.

A. If the weather outside does not prevent the pilot boat from going out:
By day: Flag S of the International Code at masthead of the pilot boat...The pilot is going out to you.
By night: A white rocket..... Do.

N. B.—In a rough sea preventing the pilot from coming aboard, the pilot boat must make the following signals on nearing the ship:
By day: Signal N G S of the International Code.....Follow the pilot boat. The pilot will come aboard under the lee of the breakwater.
By night: A blue light..... Do.

B. If the weather outside prevents the pilot boat from going out:
By day: Signal T J P of the International Code (hoisted at the Port Said electric lighthouse).....The pilot boat can not go out.
By night: A red rocket..... Do.

SIGNALS TO BE MADE USE OF IN THE HARBOR.

By day: Flag S of the International Code or national pilot flag.....Send me a pilot.
By night: Three white lights at the foremast head on the same halliard..... Do.

N. B.—Pilots for navigation in the canal are due on board only 1 hour and 30 minutes after the signal has been hoisted.

2. Port Thewfik.

SIGNALS TO BE MADE USE OF IN THE ROADS.

Flag S of the International Code.....Send me a pilot, as I wish to moor at the dock buoys in Port Thewfik.
Flag T of the International Code.....I give up my intention of mooring at the dock buoys in Port Thewfik.

N. B.—Ships made fast on the buoys of the dock are not allowed to get underway for the roads before having received a verbal order from the company's officials.

APPENDIX XXII.

TRAFFIC REGULATIONS AND CODE OF SIGNALS OF THE KAISER WILHELM CANAL.

Appendix XXII.

TRAFFIC REGULATIONS AND CODE OF SIGNALS OF THE KAISER WILHELM CANAL.[1]

[Issued by the Imperial Canal Administration.]

Section 1.—*General rules.*

1. Every master of a vessel using the canal must keep on board a copy of these regulations, which are obtainable on request. They govern the relations between the canal office and the master or owner of the vessel. The master is responsible for the exact compliance with these regulations, as well as with the customhouse regulations on the part of the entire personnel of his vessel.

Differences arising between the canal office and the master or owner or part owner of a vessel passing through the canal are adjudicated in the first instance by the "Landgericht" at Kiel, unless the case comes within the jurisdiction of an inland court.

2. Passage through the canal by day or night is granted to vessels of all nations on payment of the authorized fees tabulated at the end of these regulations, or on presentation of a passage ticket. (See Appendix IV in Report on Panama Canal Traffic and Tolls.)

Vessels must not exceed the following dimensions:

Draft	8 meters, or 26.24 feet.
Beam	20 meters, or 65.60 feet.
Length	135 meters, or 443.00 feet.
Masthead above water line	40 meters, or 131.20 feet.

Foreign war ships and other military vessels must obtain permission through diplomatic channels before entering the canal.

3. The canal office reserves the right to refuse passage entirely, or to grant it only under certain conditions (see also No. 5), in the following cases:

(*a*) Open or not fully decked vessels of less than 0.50 meters freeboard.

(*b*) Vessels carrying a deck load impairing their stability or ability to maneuver.

(*c*) Vessels known to have poor steering ability in the canal or objectionable on account of their condition or crew.

4. Floating devices differing from the ordinary form of a ship are not allowed to use the canal without being granted a special permit on each trip by the imperial canal office, and not without adhering strictly to rules and directions. Rafts are not admitted under any circumstances.

5. Steamers ordinarily pass under their own power, but in some cases, especially if the steamer's velocity averages less than 8 kilometers per hour, the management (traffic manager, harbor masters) can order towing, or can send one or more tugboats to the vessel's assistance. In such event the authorized towage fees must be paid.

The term "steamer" in these regulations includes all machine-propelled vessels, electric, gasoline, petroleum, etc.[2]

6. The following classes of sailing vessels are subject to towage:

(*a*) Those of any size going through the entire canal.

(*b*) Those of more than 35 gross register tons going to or coming from stations on the canal or communicating water routes.

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[1] Translated by Chaplain Franz J. Feinler, First Infantry, U. S. Army.

[2] Special rules for the towing of vessels through the canal are given in Section VIII, Nos. 46-60, of this Appendix. See also Appendix IV in the Report on Panama Traffic and Tolls.

7. Sailing vessels not subject to towage can use their sails only under more than half wind; otherwise they must be towed. They must always allow steamers to pass, keeping to starboard. Sailing at night [1] and in dark weather, and cruising in the canal or in the channels of the canal harbors is prohibited, and towing is allowed only when done by hand power.

8. All vessels navigating the canal are subject to pilotage, unless exempted by section 9.

The canal office decides whether a vessel in tow requires a special pilot besides the tug's captain or her pilot.

9. Only such sailing vessels are exempt from pilotage as are not subject to towage, and small, open, or half-decked steam, motor, or row boats. The traffic manager can, however, allow further revocable exemptions.

The masters of vessels exempt from pilotage must, without waiting for signal, keep out of the way as much as possible of all larger boats and tows approaching or overtaking them. They must also obey promptly and exactly orders and directions of the canal police, and especially of the canal master and pilots.

10. Canal pilot stations have been established: (1) At Brunsbuettel, (2) at Holtenau, at the two canal ends; (3) at Nuebbel (kilometer 57.2), where pilots ordinarily change when vessels pass through the entire canal.

The canal pilots usually come on board: (1) At Brunsbuettel, on the Elbe outside the canal harbor; (2) at Holtenau, between the lighthouse, near Friedrichsort, and the canal entrance, or in the harbor of Holtenau, for vessels coming from Kiel.

11. When a vessel requires a canal pilot she shall, in the daytime, as soon as possible, hoist at the foremast the national pilot flag with the answer pennant of the International Signal Code underneath. During the nighttime there are to be displayed at the bow two lights, side by side, and at least 1 meter apart.

Counter signals "understood," namely, signal No. 40, are given only in the nighttime from the pilot stations Holtenau and Brunsbuettel. It will be extinguished as soon as the pilot starts for the vessel. If for some reason a pilot is not available, then the pilot stations at both canal ends display:

(*a*) In the daytime pennant D of the International Signal Code under the imperial service flag.

(*b*) At night three red lights in a vertical line.

12. The vessels subject to pilotage are the following:

(*a*) Those approaching the canal from the lower Eider River may take their pilots on board at the station of Nuebbel, but the pilot is only as a passenger to the canal zone limits at kilometer 65.

(*b*) Vessels coming from Kiel Bay can obtain their pilot before starting for the canal if their request with exact time and place of departure is presented to the harbormaster at Holtenau early enough, and they either provide or pay for the pilot's transportation from Holtenau.

(*c*) Vessels starting from an anchorage on the canal or near Rendsburg must make an early request at the nearest pilot station, giving exact time and place of departure. (This request can be transmitted free from the nearest telephone of the canal office.)

The pilots must be paid the authorized fee at their arrival on board. (For schedule of pilotage charges see Appendix IV in Report on Panama Canal Traffic and Tolls.)

An equal pilotage charge is authorized on vessels terminating their trip at places named in (*c*), or leaving the canal at kilometer 65.

On demand, the pilots must acknowledge receipt of fees.

13. On boarding the vessel the captain must acquaint the pilot of any peculiar steering qualities of the ship, and, if requested, full information concerning the vessel, crew, cargo, etc.

14. After assuming his duties on board, the pilot is responsible for the steering of the vessel through the canal. He also acts as revenue officer, and within certain limits as police officer on board.

[1] "Night" in the regulations means the time during which the canal lights are in use; "day," the rest of time.

The master and all members of the crew must obey strictly each and every order and direction given by the pilot in the exercise of his duties, as mentioned above. The master must direct his crew accordingly, and is responsible for their compliance.

15. The master or other suitable representative (helmsman, officer) must, if the pilot so desires, stay on the bridge as an assistant (that is, by operating the machine telegraph, paying special attention to the steering, etc.).

16. All vessels using the canal are obliged to give free transportation to pilots who are directed by the harbormasters or the chief pilot to go to certain places along the canal. These pilots and also the canal pilots entrusted with the guiding and superintendence of the vessel must be admitted on their request while on board to the regular meals of the captain or master, for which the pilot must pay directly at standard prices. If necessary, the pilot shall also receive gratis proper shelter and sleeping accommodations on board. When unable to supply such, the master must pay a compensation of 1.50 marks to the pilot on duty who is obliged to find a sleeping place ashore.

The master must supply the pilot in charge of the vessel on request at a proper price, with light refreshments (coffee, tea, broth, sandwiches, etc., but never intoxicants).

The higher officials of the canal office have free passage on all vessels using the canal. On request they shall receive board and lodging according to rank and at proper prices.

SECTION II.—*Preparation for the canal trip.*

17. Every master who wants to use the canal must fill out accurately the application blank in duplicate, according to the prescribed model. (See Appendix IV in the Report on Panama Canal Traffic and Tolls.) These blanks, together with the ship's papers and other documents necessary for computing the canal fees, must be kept ready at the canal entrance, unless an agent on land attends to this duty.[1]

18. The revenue signals (pennants and lights according to Nos. 2 and 5 of the customs regulations) are to be kept ready; tenders (see No. 28) shall also have a green globe light. If necessary, the pilot is to give notice that they are to be rented from the canal office.[2]

19. Sailing vessels must fasten all their sails, brace the yards sharp to larboard in line with the keel, reef the bowsprit, and keep a sufficiently strong tug hawser ready; in short, they must keep themselves ready to be towed.

20. In addition, the following preparations shall be made:

(1) Vessels of more than 50 tons gross register must have a bow anchor and a sufficiently strong stern anchor ready for use. (See No. 22, par. 3, and No. 38.)

(2) All of the ship's boats must be swung in or placed upright, with the exception of one for the carrying of cables and for use in distress. This boat must be either swung out on the starboard side or be in tow.

(3) The mastheads must be lowered, if more than 40 meters above water.

(4) The foremast must carry a halyard for the hoisting of lights and signal balls.

(5) On both sides of bow and stern must be kept cables with throw lines for entering and passing through the locks, and side fenders of unsinkable material without protruding metal parts.

(6) Steamers must keep their fire engine ready and sufficient hose for immediate use in case of fire.

(7) Ammunition must be removed from firearms.

(8) The steam whistle or siren must be inspected so as to be available for instant use. Every vessel must have at hand and ready for use:

(*a*) On day trips: Two black balls or bodies of 65 centimeters each in diameter, strung at least 2 meters apart.

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[1] The blank is supplied gratis by the pilot, who also assists in filling it out, and verifies the same.

[2] The rent for revenue signals is 2 marks, and for the green light 1 mark for each trip. Revenue signals and lights must be returned to the lock master on leaving the lock, and damage or loss of the rented utensils must be paid for at rates authorized by the canal office.

(*b*) On night trips: Two red lights of at least 25 centimeters diameter each, also at least 2 meters apart, and several white lights. All lights must be fitted with inboard screens, so as to prevent them from being seen across the bow.

SECTION III.—*Entering and passing through the locks.*

21. Steamers subject to pilotage and all tow trains are allowed to enter the canal police district only when in command of canal pilots.

Tugboats arriving at the outer harbors with a train in tow for the canal trip need not pay the fees if they leave the locks immediately after bringing their train to the inner harbor.

Sailing vessels of any description, not in tow of steamers and wishing to enter the outer harbor, must stop at the anchorage till a canal office steamer tows them in. They must signify their intention to enter by displaying the national flag on the forward stay of the mainmast or on the corresponding rope.

The outer harbor may be entered only when signal 3a is shown.

Steamers not subject to pilotage are allowed to enter only when permitted to do so by signal, and then exclusively in the fairway of the harbor and into the lock designated by signal. All directions given by officers of the canal office are to be promptly followed. They must under all circumstances either keep out of the way of larger vessels entering or clearing and trains of tows, or drop astern.

22. The order of admission to the canal generally depends on the time of arrival at the harbor; the authorities, however, have the right to make different arrangements.

The steamers of the canal office assist in entering and leaving, and no special charge is made for this.

On entering the outer harbors, bow and stern anchors must be manned and ready for instant use.

23. Every vessel passing through the canal must stop at the locks or at any other place indicated by the canal police officer in order to make out and verify the fees for passage and towage, and to attend to the customs declaration.

23a. The vessel must leave the lock chamber promptly, but only after being authorized to do so by the master on duty. The propeller should start easily, with slow acceleration, and passage through a chamber open at both ends should be very slow.

SECTION IV.—*The passage through the canal.*

24. The passing of vessels, arrangements of lights, etc., are governed by the Navigation Rules of February 5, 1906 (Imp. Law Gazette, p. 120 et seq.) somewhat modified by these traffic regulations, and the further rule that the second light prescribed in article 2 of the Navigation Rules should, on the canal trip, be carried at the masthead, notwithstanding the vertical arrangement indicated in (*a*) and (*e*) of that article.

25. No vessel shall exceed a speed of 15 kilometers, or 8.1 nautical miles, per hour, and vessels of over 2,000 tons gross register and drawing more than 5 meters (16 feet 5 inches) shall not exceed the speed of 12 kilometers, or 6.5 nautical miles, per hour.

In a tortuous channel between high banks obstructing the view, a vessel must move still slower. The management (traffic manager, harbor master) may also order a vessel to slow down, or the pilot may give such order, if in his judgment it is necessary to avoid danger to the canal works or the vessel.

26. In addition to the preceding cases (No. 25, par. 2) a vessel must slacken her speed or stop when passing:

(1) Vessels approaching head and head.

(2) Vessels swinging at their moorings.

(3) Dredges and loaded dredge scows.

(4) Gas scows engaged in filling the buoys, and diver's boats moored for diving operations (indicated by a green flag).

(5) Sections indicated by labor and danger signals.

(6) Ferries, viz, from the white painted poles of the electric light line until the ferry is reached.

(7) Lay-bys.

(8) When changing pilots at Nuebbel.

(9) When hailed by revenue officers.

(10) When the general signal (No. 35) to stop is given by a canal officer, a red flag being waved by day, a red light at night.

(11) When a lay-by tender gives the signals 25 or 32.

(12) When and as long as a ferry displays signal 33.

Slowing down in cases (2) to (6) means moving in such a manner as to avoid dangerous wave action or suction.

In the sections included by the outside signals of the swinging and pontoon bridges, the speed must never exceed 4 knots per hour.

27. The canal trip must be started and completed without delay, unless for urgent reasons or by order of the canal officials. All expenses arising for revenue service, overtime of the pilot and towboat, etc., from unjustified delay are charged to the vessel's master or owner. (For overtime tariff see Appendix IV in the Report on Panama Canal Traffic and Tolls.)

The canal office is especially empowered to cause vessels to be towed out if they remain in the canal without proper reason and to charge the authorized fees to master or owner.

Delays arising from her own or another vessel's foundering, from waiting at swinging bridges or at lay-bys, or through other measures necessary in the interest of safe traffic, do not justify a claim for damages on account of lost time.

28. All vessels using the canal must by day display their national flag and at night a white light at the stern, besides the regulation lights, unless they are sailing under revenue light. In tow trains only the last boat shall exhibit the light at the stern.

Vessels which for size or draft or other reasons pass and are passed (lay-by vessels) at lay-bys only, after approaching vessels or they themselves have moored there, display at the masthead:

(*a*) In the daytime, a black ball or body of 1 meter least diameter.

(*b*) At night, a green light instead of the second white top-light. (See sec. 24.)

In lay-by tow trains the tugboat shall carry the ball and green light.

29. Unless the pilot directs differently for special reasons, vessels pass each other by keeping to starboard; smaller vessels shall, in so far as their draft allow, leave the midchannel to the larger vessels of greater draft.

Dredges at work shall be passed only on the side signaled as "free." If for some reason a vessel can not be allowed to pass, the dredge shall distinctly exhibit signal 54, in such manner as her structural character requires, and she shall give several short blasts with the steam whistle at the approach of a vessel, till the channel is clear.

30. A proper lookout must be kept at all times fore and aft.

31. At the passing stations (lay-bys) vessels have to moor in compliance with No. 42 when the lay-by semaphore displays "stop" (signal Nos. 19, 23, 26, 30, or 33), and shall wait till they are signaled to proceed (signals Nos. 24, 31).

No vessel has the right of way through a lay-by at night, unless signal 24 or 31 is shown. If no signal can be seen at night when approaching a lay-by, the vessel shall slacken her speed or stop. She shall at the same time continue to give short blasts with the steam whistle, until she is signaled proper directions from the station.

32. Rules for the passing of the railroad swinging bridges at Osterroenfeld and Taterpfahl:

(1) If the outer semaphore on the south bank, placed 600 meters from the drawbridge, at the approach of a vessel and up to the moment when the vessel's bridge is just opposite said semaphore, displays the signal for "clear channel," the vessel must continue her course through the piers regardless of the fact that the other semaphore on the south bank, 150 meters from the

draw, should display the signal "stop." Having understood the outer signal as for "clear channel," the vessel shall signify her intention to pass through by a long blast (6 seconds) of the steam whistle.

(2) If the outer signal at the approach of a vessel reads "stop," or if it should be changed to "stop," before the vessel's bridge has passed the semaphore, then the vessel shall twice give three short blasts (1 second each) of the whistle (signal for "understood"), shall stop and make fast at the mooring posts near the semaphore, unless the signal is meanwhile changed to "clear channel." The vessel shall proceed only after "clear channel" is signaled.

33. Rules for the passing of the highway drawbridge at Rendsburg and of the pontoon bridge at Holtenau:

A vessel approaching the semaphore erected 900 meters from the bridges gives three long blasts of the steam whistle (6 seconds each) as a signal to open the bridge. The vessel or tow train shall stop, and if necessary shall make fast at the moorings before the bridge—

(1) If the semaphore or the bridge exhibits the general signal to stop (signal No. 35);

(2) If before passing, the semaphores of the highway drawbridge display by day a red ball or a red round disk, and at night a red light.

Vessels and tugboats shall indicate with three short blasts of the steam whistle that they have understood these signals. They shall not proceed till the signals at the outer semaphores of the highway bridge are changed or the waving of a green flag or lantern gives them the right of way. (Signal No. 36.) The above signal shall be given also by steamers starting west from the inner harbor of Holtenau.

34. Rowboats and other vessels exempt from pilotage (see No. 9) can not demand that the bridges (No. 33) be specially opened for them; they shall stop and if necessary make fast at the moorings before the bridge, according to the direction of the bridge tender or master, until the waving of a green flag on their side of the bridge gives them the right of way.

35. Vessels whose height permits them to pass through the closed draw need not comply with the preceding rules (32–34).

36. Rules for the overtaking of vessels ahead:

(1) The overtaking vessel shall signify her intention by four short blasts of the steam whistle.

(2) After this signal—

(*a*) Towed vessels and sailing vessels shall keep as much as possible to starboard.

(*b*) A tow train, believing that the vessel astern can pass her in the canal prism without danger to either of them shall also keep as far as possible to starboard (only on special direction of the pilot to larboard); she shall make fast, if convenient, at the posts on the bank, and by giving three blasts of the whistle (long—short—long), permit the overtaking vessel to pass. Else she shall give five short blasts, proceed to the next passing station, and there under much reduced speed keep to starboard or stop, moor, and signify her willingness to let the vessel astern pass her by three blasts of the whistle (long—short—long).

(3) Single steamers shall not be passed by others except after an exchange of the above-mentioned signals 1 and 2*b*. Steamers of more than 2 meters draft shall overtake and pass others only at the passing stations; in this case also the steamer ahead may signify her willingness to let the steamer astern pass her by five short blasts.

(4) The overtaking of tow trains by other tow trains or by lay-by vessels (No. 28) is also restricted to passing stations.

(5) In all cases shall the overtaking vessel in passing reduce her speed so as to avoid dangerous suction. Also overtaken vessels and tow trains must slow up as much as possible. Vessels of the canal office and of the revenue service, drawing not more than 2 meters are not bound by the preceding rules; they shall always be allowed to pass, if they signify their intention to do so by the signal mentioned in 1 above; and the overtaken vessel shall keep as far as possible to starboard and slacken her speed.

(6) In general, overtaking shall be permitted only where a good view ahead avoids all danger of collision, and where vessels approaching each other are as yet so far away that the

overtaking vessel is sure to eomplete her first maneuver before meeting the other vessel and to attain the interval between the overtaken vessel as prescribed in No. 39. No overtaking at all shall take place on 1,000 meter eurves.

The preceding rules do not apply to rowboats and small open or half-deeked steam or motor boats and sailing eraft. (See No. 9, par. 2.)

36a. A vessel foundered in the canal shall not be passed until signals for doing so with safety are made and understood (three blasts, long—short—long). If the foundered vessel answers with five short blasts, she ean not be passed. But after giving her assent she must stop temporarily all maneuvers likely to impede the other's movement.

37. Besides the siren signals of Nos. 31, 32, 33, 36, 36a, and 45, when going west one long blast, when going east two long blasts in rapid suecession, are prescribed in the following three cases:

(1) In fog and dark weather, at intervals of one minute.

(2) When approaching dredges at work, exhibiting danger signals No. 26 Par. 5, and ferries beginning at the white poles of the eleetric light line.[1]

(3) On entering each of the curves, that between kilometers 27–31 and that between kilometers 72–97. Steamers, not subjeet to pilotage, may by the preceding signals indieate their intention to enter the loeks at Holtenau.

38. Vessels approaehing one another head on and coming within sight of each other or vessels entering lay-bys, approaehing draws and the pontoon bridge, or putting into inner harbors shall man and elear bow and stern anehors for instant use.

39. The interval between two vessels under way shall not be less than 1,000 meters. If the distanee beeomes less without the intention of the vessel astern, it must be reestablished as soon as possible by slowing down or at the worst by stopping.

40. Vessels and tow trains going west through parts of the ehannel narrowed by dredges at work or other causes shall ordinarily pass first, but if at sueh plaees an east-bound vessel before a strong wind and eurrent should judge it dangerous to pass a vessel or a tow train head on, whieh in this case eould easily keep out of the way or stop, then she shall give the danger signal No. 54 with the steam whistle or siren. The west-bound vessel shall answer, with three short blasts, stop, or keep out of the way and let the east-bound vessel pass first.

Section V.—*General prohibitions.*

41. (1) Casting anchor in the fairway of the eanal exeept in unavoidable cases by order of the pilot.

(2) Throwing overboard ballast, eoal, ashes, or other things befouling or obstructing the channel.

If such things have fallen overboard, the place and quantity must be immediately reported to the pilot. Trying while under way to regain objects fallen overboard will not be permitted, but the eanal offiee ean order the salvage at the expense of the party requesting it.

(3) Scouring the vessel and using or diseharging the water-elosets on board while in the locks or inner harbors of Brunsbuettel and Holtenau.

(4) Shooting, hunting, fishing,[2] and bathing anywhere in the canal police district without previous permission of the eanal offiee.

(5) Making fast at the poles of the telegraph and eleetric lights.

(6) Stieking hooks or pole propellers into the banks above or under water.

(7) Using the steam whistle or siren exeept upon the oeeasions and in the manner preseribed by the management.

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[1] Vessels going east shall not sound the signal for the ferry at Kudensee (kilometer 6.3) till the vessel's bridge passes the piers of the railroad bridge near Taterpfahl.

[2] This restriction does not apply to the exercise of private fishing privileges in the public waters along the canal. These are subject to the executive order No. 18 of the fishing law in the Province of Schleswig-Holstein, Aug. 8, 1887 (G. S., p. 376).

SECTION VI.—*Special provisions.*

42. Landing and tying up.

(1) As a rule, mooring is allowed only in the lay-bys, at the guide walls of the locks, at the posts before the drawbridges as far as the danger signal unless the red painted heads mark them as not to be used for mooring, at quays and docks, and the moorings of the inner harbors and the canal docks.

(2) In cases of necessity, or as specified in No. 36 (2*b*), vessels may also make fast at the posts placed alongside the entire canal.

(3) As a rule, vessels shall moor at larboard; it should not be done at starboard unless a strong wind blows at right angles to the canal from that side, or when the larboard side is already fully occupied.

(4) Mooring with steel cables, except at the inner harbors, should as much as possible be avoided.

(5) At the lay-bys steamers and tow trains shall always moor at the farthest posts ahead, unless the station master expressly directs differently; his orders shall be promptly obeyed in the zone between the outer semaphores.

(6) Vessels which wish to or are obliged to make fast in the lay-bys (from the red painted lightpole on their side), or in the canal prism, shall display the same signal as when foundering (No. 45). The signal should not be taken in, unless they are fast in such a way that other vessels can pass without danger. At night the side lights should be extinguished, and one white light ahead and one abaft in the direction of the channel should be exhibited as low down as possible. In tow trains the tugboat displays the signal. For tow trains of more than one tow barge it is sufficient if each vessel on the channel side exhibits one white light on that side, the vessel ahead at the bow, the hindmost vessel at the stern, and the others amidships.

43. Lying at anchor.

(1) Men and tools shall be kept ready on every vessel at anchor to take down or cut the cables when other vessels are passing.

(2) Cables obstructing the channel must, as soon as possible, be removed if another vessel desires to pass.

(3) Trying out the ship's engines at the docks is permitted only with the least amount of steam power for a few minutes just before starting.

(4) Vessels at anchor in the lakes of the upper Eider (from kilometer 65–70.8) shall display under their anchor light another red light.

44. Getting under way.

The rule is that the vessels ahead start first; orders of the station master deviating from this rule must be promptly obeyed.

If vessels have at the same time moored at both sides of the drawbridges, then the west-bound vessels start first, and the east-bound wait until the others have passed.

45. Foundering and distress.

(1) If a vessel is aground and suffers such an injury to her hull or engine, as to require immediate stopping, she shall indicate this fact to approaching vessels by short blasts of her whistle in rapid succession, and shall without delay hoist these signals.

(*a*) By day: 2 black balls or bodies 2 meters apart in vertical line above each other and hoisted at the foremast.

(*b*) At night: 2 red lights 2 meters apart in vertical line above each other at the foremast.

The balls or lights shall be so constructed and so fitted, that they can be seen distinctly forward and abaft. The side lights, and upon steamers the white top lights also shall be extinguished or screened.

Also, after this signal has been displayed, the vessel shall continue to sound short blasts of the steam whistle at the approach of other vessels.

(2) Only the officials of the canal office are authorized to take the necessary measures to assist vessels run aground, or for the salvage of sunken vessels, and they alone may requisition help. The expense incurred are charged to the vessel.

(3) Assistanee by other than canal office vessels is allowed only by speeial approval of the offieials. Any requisitions of the officials shall be eomplied with by other vessels.

(4) For the passing of other vessels see No. 36a.

Section VII.—*Leaving the canal.*

45a. Rules for leaving the canal.

(1) It is necessary to enter the loek at which signal 6 or 7 is exhibited, and at much reduced speed.

(2) In the absenee of a signal a vessel shall promptly stop and, if so directed, shall make fast.

(3) The rulings of Nos. 23 and 23a are here also strictly applicable; in no case shall a vessel leave the lock, before presenting its application blank.

Section VIII.—*Rules for towing vessels.*

46. For towing sailing vessels through the eanal, and others not provided with sufficient motive power of their own, the canal offiee keeps ready at both entranees a number of tugboats which are available upon payment of towage charge.[1] But no responsibility is assumed that always and under all circumstances a sufficient number of tugboats will be available.

Vessels having previously ordered a tugboat are served before other vessels in the order of applieation; but they shall pay demurrage for every hour or fraction thereof, according to the demurrage tariff, if they are not eleared for towing within two hours after the starting time announeed.

The masters and helmsmen of these tugboats exercise simultaneously the funetions of eustoms offieers, and within proper authority also of poliee offieers on all vessels of their tow trains.

47. If a vessel does not require a special tugboat for herself alone, or if the authorities at the entranee harbor decide that a vessel on aeeount of size or insufficient maneuvering in the eanal requires individual towing, as lighters, praams, and clumsy barges generally do, then the vessel shall be attached to a tow train of a regular tugboat of the canal office, or of one put temporarily into the canal service.

48. No tow trains, as a rule, are started on Sundays, the two Christmas holidays, Easter, and Pentecost Mondays, New Year, Good Friday, Ascension Day, the Day of General Penance and Prayer, Emperor's birthday, and on speeially authorized holidays. Special tugboats are furnished only as an exception and for suffieiently strong reasons. The tow trains of the canal offiee always make fast at night.

49. The master who wants to tow his vessel in a tow train of the eanal offiee, must report to the harbor master on duty, by whom he will be promptly told, at what time to start and to what tow train his vessel will be attaehed. The master shall see to it that his vessel is clear at the time set for towing and that the towage is paid. The vessels to be towed must possess towing cables that come up to requirements.

50. The tow trains are made up at the inner harbors of Brunsbuettel and Holtenau by the harbormaster on duty, whose orders shall be promptly obeyed. The harbormaster also decides, on what vessels the pilots of the tow train shall be stationed.

51. Masters who want to attaeh their vessels at anchorages along the canal or in the lakes of the upper Eider (kilometer 65–70.8), to a tow of the canal office, shall make their request from the nearest canal telephone, giving exact name of vessel and master, places of departure and destination, gross tonnage (in register tons), and statement as to whether fully or partially loaded or empty. The application is to be made only after the vessel is cleared for towing.

The vessel shall be ready for towing at the time set (No. 19), and shall signify her readiness by hoisting the national flag at the stay of the mainmast on the channel side.

At the approaeh of the respeetive tow train the tugboat gives one prolonged and one short blast of the steam whistle; the vessel to be towed then holds the towing cable ready for throw-

[1] For towage and demurrage tariffs see Appendix V in the Report on Panama Canal Traffic and Tolls.

ing over, keeping close to the fairway in order to save the tugboat from leaving her course, but not so close as to obstruct other traffic in the canal.

Vessels not reported according to regulations shall not be attached to tows of the canal office.

52. The tugboats of the canal office as a rule do not go outside the canal proper. Vessels destined for locks on the Eider can be towed only as far as the channel buoy in the lake of Audorf, at kilometer 65. Vessels coming from there and wishing to join a tow of the canal office must do so at the same buoy.

53. A vessel which is not ready to get under way with her tow at the place of departure, or which after having made application for towing from a harbor along the canal misses her train through her master's or her crew's fault, or which has not in proper time withdrawn her application, loses thereby her claim for abatement of accrued or return or already paid towage, and she can thereafter be attached to a tow of the canal office only after making another application and paying the charges specified in the towage tariff.

54. If possible, the tow trains of the canal office are run through without stop. The wishes of individual masters for stops can not be noticed. If a vessel intentionally leaves her train short of her destination she can not claim a return of the proportional towage paid or partial abatement of the towage payable according to the application.

55. If the tow train does not start or arrive on schedule time to take vessels along, or if delays happen from any cause during the trip, no claim for indemnity can on that account be made upon the canal office.

The Imperial Government, moreover, will not pay damages to a vessel towed by a tug of the canal office on account of injury caused through carelessness on the part of the tug's crew or other personnel of the canal office engaged in the towing of the vessel inside of the canal police district.

56. Vessels going beyond Brunsbuettel or Holtenau, on the Elbe or Keil Bay, are towed as far as the respective ports. For leaving the tow train here as well as inside the canal they shall await the order of the tugboat master or the pilot, and shall maneuver as directed by him until clear of the tow.

57. The rules of Nos. 49, 51–56 call for analogous application to the towing of single boats or other vessels by steamers of the canal office.

58. In addition to the tugboats of the canal office, steamers owned by the Imperial, State, or city governments or by private parties, etc., may also be employed in the towing service of the canal, if their construction, arrangement, engines, etc., qualify them for such work according to the authoritative judgment of the canal office.

59. Special rules for this auxiliary towing service:

(1) The tugboats are obliged to pay the regular canal tolls.

(2) The length of the train—from the stern of the tug to the stern of the last vessel—must not exceed 125 meters, and its width 20 meters.

(3) More than two vessels shall not be in a tier.

(4) Towing alongside requires special permission and must be conducted according to specified conditions.

(5) On entering the mouth of the canal or the locks the train must, upon demand, be divided as directed by the authorities.

(6) Tow trains may run 12 kilometers per hour, but this speed should be reached only in sections with a good view ahead. On the other hand, the tugboat must be so powerful that she can pull her train with a speed of at least 9 kilometers per hour, else the canal office may divide the train and, if necessary, may tow the separated part with a canal tug at the tariff rate, or if this can not be done the tug may, at her own expense, be given an auxiliary steamer of sufficient power.

(7) A vessel of more than 400 tons gross register must have a tug of its own.

(8) Tow trains are not run at night nor in dark or stormy weather. Trains under way must therefore arrange their schedule so that they can make fast in a lay-by before nightfall.

If caught in bad weather before reaching a lay-by, they may moor at the posts on the bank. (See also No. 42.)

60. All towboats in a train must during the trip be steered by an adult expert, and the wheel must be exactly in the position required by the tugmaster or pilot.

SECTION IX.—*General police regulations.*

61. Vessels carrying explosives weighing more than 35 kilograms shall distinctly display a black flag with a white P. These vessels are, moreover, subject to the existing regulations for the traffic of explosives and combustibles.

Vessels of a cargo of this kind shall be completely isolated and, if necessary, they shall be towed through by a special tug without any stop.

This rule does not apply to the ammunition of warships.

62. Vessels carrying cattle from countries against which the Province of Schleswig-Holstein has established import and transit embargoes or restrictions may pass through the Kaiser Wilhelm Canal under the following conditions:

(1) Animal waste shall not be removed from the vessels nor shall it be thrown into the water during the canal trip.

(2) Persons engaged in the care and feeding of the animals on board, or who come in contact with them, shall not go ashore during the canal trip.

(3) An officer of the canal office shall accompany every cattle ship to see that these rules are complied with, and a fee of 13 marks is charged therefor, payable in addition to the other charges. For vessels entering or leaving the canal at kilometer 65 this fee is 8 marks.

63. Every vessel passing through the canal is subject to surveillance by the board of health:

(1) If she had on board at the port of departure or during the voyage, or at any time during the last six weeks, Asiatic cholera, spotted fever, yellow fever, oriental plague, or smallpox.

(2) If rat pest or any unusual mortality among rats was noticed on board, either in the port of departure or during the voyage.

(3) If the vessel comes from or touches at a port whose commerce is subject to inspection at the time of her arrival and which she has left within six weeks.

(4) If, in other cases, existing or proposed regulations or considerations of duty on the part of the president of the imperial canal office, as the royal Prussian police representative having jurisdiction in the premises, require surveillance of the vessel in the interests of the public health.

The inspection takes place at the quarantine stations at Vossbrook or Groden, near Cuxhaven, as directed by the proper authorities. The canal office has power to require special precautions, viz, health watch, locking of water-closets, etc.

The expenses are charged to the vessel.

These vessels are admitted to the canal only after this supervision is in force. The masters of the vessels are obliged to comply strictly with the precautions ordered and to promptly obey the directions of the pilot or canal officer accompanying the vessel. The latter's fees are the same as those of the special watch on a cattle ship, as prescribed in No. 62.

SECTION X.—*Complaints.*

64. Any complaints against the officials or about the facilities of the canal are to be presented in writing at the canal office to the traffic manager, or the harbor masters at Holtenau and Brunsbuettel. At the latter places they are to be recorded in a book of complaints.

Kiel, February 23, 1911.

THE PRESIDENT OF THE IMPERIAL CANAL OFFICE.

CODE OF SIGNALS—KAISER WILHELM CANAL.

FROM SHORE TO VESSELS.

A.—From Harbor Semaphores.

No. of signal.	Meaning of signal.	Signal by day.	Signal by night.
1	You can not enter	On a mast 20 meters high, north of entrance, 2 yards slanting upward.	On a mast 20 meters high, north of entrance; 2 red lights side by side.
2	You can enter	Like No. 1, but yards downward	Like No. 1, 2 green lights side by side.
3	That vessel can enter whose pilot holds the pennant or night signal.	Like No. 2, but one or more flags of the International Signal Code on the cross arm.	Like No. 2, adding 1 to 3 red or white or red and white lights under the 2 green lights.
3a	You can enter the outer harbor	Like No. 1, with pennant F of International Signal Code at the cross arm.	No signal.
4	Entrance gate is closed	No signal	4 red lights in square above the entrance.
5	Exit gate is closed	do	4 green lights in square above the exit gate.
6	You are ordered to enter the chamber to your left.	At the cross of the nearest chamber head, 1 green ball at the upper left.	On the nearest chamber head, 1 green light.
6a	The chamber to your left is set ready for the vessel waiting in the inner harbor.	Like No. 6, but the ball at half-mast	On the inner chamber head; 1 white light above the green.
[1] 6b	Tow trains and dredges are permitted to enter the left chamber.	Like No. 6, but pennant F of International Signal Code in the place of the green ball.	On the nearest chamber head; 1 white light to the left of the green.
7	You are ordered to enter the chamber to your right.	At the cross of the nearest chamber head; 1 red ball at the upper right.	On the nearest chamber head; 1 red light.
7a	The chamber to your right is set ready for the vessel waiting in the inner harbor.	Like No. 7, but only on the inner chamber head is the ball at half-mast.	On the inner chamber head; 1 white light to the right of the red.
[1] 7b	Tow trains, dredges and dredge praams are permitted to enter the right chamber.	Like No. 7, but pennant F of the International Signal Code in the place of the red ball.	On the nearest chamber head; 1 white light to the right of the red.

B.—From Railway Drawbridges.

8	Right of way clear	Outer signal: 10-meter semaphore on the south bank; 2 arms slanting downward.	Same, with green light.
9	do	Cautionary signal: 10-meter semaphore on the south bank 150 meters from the bridges; horizontally lying square shape.	Do.
10	do	Bridge signal; semaphore on pivot pier; red shape in line of canal axis.	Do.
11	Outer signal: Stop till signals Nos. 8 and 9 appear.	Same as No. 8, with arms slanting upwards	Same as No. 8, with red light.
12	Cautionary signal: Stop till signals Nos. 8 and 9 appear.	Same as No. 9, red square shape crossed to the canal.	Same as No. 9, red light.
13	Bridge signal: Stop till signals Nos. 8 and 9 appear.	Same as No. 10, a round red shape crossed to the canal.	Same as No. 10, red light.

C.—Signals from the Wagon Drawbridge at Rendsburg and from the Praam Drawbridge at Holtenau.

14	Outer signal: You should give signal No. 48 with siren.	On 5-meter semaphore 900 meters from bridge; red round shape.	Same, green light above red.
14a	Outer signal for the wagon draw: Stop till signal is taken down.	Semaphore red ball or red round shape	Same, red light.
15	Bridge signal: Bridge is open	Semaphore on pivot pier; red shape in line of canal axis.	Same, green light.
16	Same place: Bridge is closed	Red shape crossed to the canal	Red light.
17	Bridge signal on the praam draw at Holtenau: Bridge is open.	No signal	Green light on the opened bridge span.
18	Same place: Bridge is closed	1 red round shape on each of the 2 spans	2 red lights.

[1] Only for Brunsbuettelkoog.

CODE OF SIGNALS—KAISER WILHELM CANAL—Continued.

FROM SHORE TO VESSELS—Continued.

D.—Signals from the Passing Stations to the Vessels.

(1) for west-bound vessels (east signals) on north arm.

No. of signal.	Meaning of signal.	Signal by day.	Signal by night.
19	Vessels of more than 2 meters draft shall stop and make fast.	A red ball	A red light.
20	Switch vessels, stop and make fast	3 red balls	A red light above a white.
21	All vessels stop and make fast (blockade)	4 red balls	A white light above a red.
22	Tow trains only stop and make fast in the passing station.	A red ball above a red flag	No signal.
23	Tow trains stop and make fast in the next dock.	A red flag above a red ball	Do.
24	Right of way clear	Taking down the signal to stop or no signal	A green light.
25	Go slow or stay where you are till the passing station is clear.	2 red balls	A green light above a white.
25a	Switch vessels shall go slow	2 red balls above a red flag	2 white lights, one above the other.

(2) Signals to east-bound vessels (west signals) on the south arm of the semaphore.

26	Vessels of more than 2 m. draft stop and make fast.	A red cone	1 red light.
27	Switch vessels stop and make fast	3 red cones	1 red light above a white.
28	All stop and make fast (blockade)	4 red cones	1 white light above a red.
29	Only tow trains stop and make fast in the passing stations.	A red eone above a red flag	No signal.
30	Tow trains stop and make fast in the next dock.	A red flag above a red cone	Do.
31	Right of way elear	Taking down the signal or no signal	1 green light.
32	Go slow or wait till the passing station is elear	2 red cones	1 green light above a white.
32a	Switch vessels slow down	2 red cones above a red flag	2 white lights, one above the other.

E.—Signals from Ferries to Vessels in Both Directions.

33	You can not pass	On a semaphore near the ferry, 2 red balls, one above the other.	Same place, a red light.

F.—Places of Danger and Work.

34	Wave aetion endangers the banks	White shapes, marked "A" for the beginning and "E" for the end.	Same, with a green light above.

G.—General Signals for Stopping.

35	Stop; there is an unforseen obstruction	Waving of a red flag from the bank or the bridges.	Waving a red light.
36	The obstruction is removed; proceed [1]	Waving a green flag	Waving a green light.

H.—Signals from Dredges.

37	Channel side	Green ball	Green light.
38	(Blank space in the original.)		

I.—Wreck Signals.

39	Wreek	A green barrel and a broom on top	A white light above the barrel and broom.

[1] The voice may be substituted for the signal.

CODE OF SIGNALS—KAISER WILHELM CANAL—Continued.

FROM SHORE TO VESSELS—Continued.

K.—Signals from Pilot Stations.

No. of signal.	Meaning of signal.	Signal by day.	Signal by night.
40	Signal 43 has been understood	No signal	3 white lights, one under the other on the entrance semaphore, beneath the signals Nos. 1 and 3.
41	Pilot can not come on board	Pennant D, International Signal Code	3 red lights, one above the other.
42	Pilot steamers under way on duty	Pilot flag	A white top light, 2½ meters beneath a red; both lights are visible over the whole horizon.

SIGNALS FROM VESSELS TO PILOT STATIONS.

43	Pilot requested	National pilot flag or signal FT, International Signal Code, both with answer pennant beneath.	2 white lights side by side at the bow.

SIGNALS FROM VESSELS ON THE CANAL.

A.—Signals to the Passing Stations.

44	Switch vessel	A black ball or shape hoisted to top of main mast.	A green light in place of the second white top light.
45	I am waiting outside the passing station because I saw no signal displayed.	Continuous short blasts with the whistle or siren till a signal appears.	Same as day signal.

B.—Signals to the Railway Draws.

46	I found outer signal "clear" and am passing the bridge.	At the cautionary signal (confer No. 8), 1 long blast with the whistle or siren.[1]	Same as day signal.
47	I have found outer signal "stop." I stop and make fast.	Same place, twice 3 short blasts	Same signal.

C.—Signals to Highway Drawbridge at Rendsburg to the Pontoon Drawbridge at Holtenau.

48	Open the bridge, I want to pass	At the outer signal (confer No. 14), 3 long blasts	Like day signal.
49	I have understood the signal to stop No. 16 (or No. 18). I stop and make fast.	Twice 3 short blasts	Do.

D.—Signal: "Attention."

50	In fog and dark weather, passing through the curves between kilometers 27 and 31 and kilometers 72 to 97, when approaching vessels, dredges, dredge and diver praams, places marked with signal No. 35, boats, ferries, and passing stations.	Long blasts; west bound, 1 each time; east bound, 2.	Same signal.

E.—Signals When Overtaking.

51	I want to overtake your vessel	4 short blasts	Same signal.
52	I am ready to let you pass	3 blasts, long—short—long	Do.
53	I can not let you pass now	5 short blasts	Do.

[1] Long blasts last 6 seconds; short, 1 second; intervals between blasts are 6 seconds.

CODE OF SIGNALS—KAISER WILHELM CANAL—Continued.

SIGNALS FROM VESSELS ON THE CANAL—Continued.

F.—Distress Signals.

No. of signal.	Meaning of signal.	Signal by day.	Signal by night.
54	I am aground or I am unable to maneuver	2 black balls or shapes at least 2 meters apart, at the mainmast or at another place, where they can be best seen from ahead and astern. Continuous short blasts are sounded till balls are displayed.	2 red lights in place of balls. The side lights, and on steamers also the white top-lights, shall be extinguished or screened when the vessel is aground. Continuous short blasts are sounded till lights are displayed.
55	Had an accident on vessel or engine; must stop immediately.	Continuous short blasts of the whistle or siren	Same signal.

G.—Fog Signals.

56	Vessel is west bound	Every minute, 1 long blast of the steam whistle or siren; sailing vessels with the foghorn.	Same.
57	Vessel is east bound	Every minute, 2 long blasts	Do.
58	Vessel is not under way	Striking the vessel's bell at least every 2 minutes.	Do.

SIGNAL OF THE TUGBOAT TO VESSELS TO BE TOWED.

59	I fetch you, cut loose	2 blasts, long—short	No towing.

DIRECTION OF CURRENT.

60	East current	Ball at top of semaphore	1 white light in same place.
61	West current	Cone on top of semaphore	2 white lights in same place.

APPENDIX XXIII.

REGULATIONS AND BY-LAWS AND NOTICES TO MARINERS AND PILOTS GOVERNING THE USE OF THE MANCHESTER CANAL.

Appendix XXIII.

REGULATIONS AND BY-LAWS AND NOTICES TO MARINERS AND PILOTS GOVERNING THE USE OF THE MANCHESTER SHIP CANAL.

TABLE OF DISTANCES.

	Side of canal.	Canal sectional number.	Distance from—	
			Eastham Locks.	Manchester.
			Miles.	*Miles.*
*Eastham Locks (6 miles from Prince's Landing Stage, Liverpool, 19 miles from Bar Lightship)	.....	1	.....	36
Eastham Lay-by and Sheer Legs	S.	1–3	¼	35¾
Bankfield Wharf	S.	3–4	⅝	35⅜
Hooton Wharf	S.	6	1¼	34¾
Mount Manisty	N.	8–9	1⅞	34⅛
Pool Hall Wharf	S.	11	2⅜	33⅝
Ellesmere Port	S.	16–17	3¼	32¾
Stuart Wharf	S.	18	3½	32½
Pontoon and ship-repairing yard	S.	19	3¾	32¼
Stanlow Wharf	S.	21	3¾	32¼
Ince Rock Cutting—Lay-by for large vessels	S.	31	6	30
Ince Ferry	.....	31–32	6⅛	29⅞
Ince Wharf	S.	34	6⅝	29⅜
Weaver Sluice	N.	43–44	10	26
Weston Point	S.	48–49	10¾	25¼
Weston Mersey Lock	N.	48	10¾	25¼
Delamere Dock	S.	49–50	11⅛	24⅞
Salt Union (Ltd.) Works	S.	.....	11¼	24¾
Bridgewater jettles and coal tip	S.	51	11⅝	24⅜
*Runcorn Lay-by	S.	52	11½	24½
Bridgewater Lock	N.	53–54	11¾	24¼
Runcorn Docks	S.	54–55	12	24
Runcorn Railway Bridge (fixed)	.....	59	12½	23½
Runcorn (old quay) Lock	N.	61	13	23
Old Quay Lock Wall Lay-by	N.	62	13	23
Runcorn (old quay) Swing Bridge	.....	65–66	13¼	22¾
United Alkali Co., Wigg's Works	N.	67–68	13½	22½
Turnbridge Ferry	.....	69–70	14	22
Stone Delph Lay-by	S.	74–75	15⅛	20⅞
Old Randles Sluices	N.	76	15⅜	20⅝
Pumping station	N.	77–78	16⅛	19⅞
Moss Lane Wharves	N. & S.	77–78	16½	19½
Moore Lane Swing Bridge	.....	80–81	17⅛	18⅞
Haydock Coal Wharf and Lay-by	N.	80–81	17⅝	18⅜
L. & N. W. and G. W. Railway Viaduct (fixed)	.....	81	17⅞	18⅛
Walton Wharf	S.	81–82	18⅛	17⅞
Stag Inn Swing Bridge	.....	81–82	18¾	17¼
Warrington Wharf and Walton Lock	N.	81–82	19	17
Northwich Road (Wildersp'l) Swing Bridge	.....	84	19⅜	16⅝
20-Steps Lock (junction with Runcorn and Latchford Canal)	N.	84	19⅜	16⅝
Latchford High Level Bridge—Chester Road (fixed)	.....	89	20⅛	15⅞
Knutsford Road Swing Bridge	.....	89–90	20⅜	15⅝
Lay-by for large vessels	N.	90	20½	15½
L. & N. W. Railway Viaduct (fixed)	.....	90	20¾	15¼
*Latchford Locks (rise 14 feet 6 inches)	.....	90–91	21	15

* Fresh water may be obtained at these places.

TABLE OF DISTANCES—Continued.

	Side of canal.	Canal sectional number.	Distance from—	
			Eastham Locks.	Manchester.
			Miles.	*Miles.*
Perrin's (Ltd.) Works			21¼	14¾
Thelwall Ferry		93	21¾	14¼
Statham Wharf	S.	96–97	22⅞	13⅛
Statham Brickyard	N.	96	23	13
Rixton Junction (junction with Mersey and Irwell navigation)	N.	99	24	12
Warburton Wharf	S.	102	24½	11½
Warburton High Level Bridge (fixed)		102–103	25⅛	10⅞
Warburton Wharf	S.	102–103	25¼	10¾
Hollins Ferry		102–103	25½	10½
Millbank Wharf	S.	104	26	10
Lancashire Patent Fuel Co. (Ltd.) Wharf	N.	107	26½	9½
Cadishead Wharf	N.	108	26⅝	9⅜
Cheshire Lines Viaduct (fixed)		109–110	26⅞	9⅛
Partington Coal Basin and Lay-by	N. & S.	111–112	27⅛	8⅞
Peaksnook Wharf	S.	112	27⅜	8⅝
Carrington Wharf (Manchester Corporation)	S.	113	27⅞	8⅛
Manchester and Salford Corporation Wharves	N.	114		
Mersey Weir	S.	115	28	8
Cheshire Lines Viaduct—Liverpool & Manchester (fixed)		115–116	28⅛	7⅞
Irlam Wharf	N.	116	28⅛	7⅞
Irlam Locks (rise 16 feet)		117–118	28⅜	7⅝
Irlam Ferry		119	28⅝	7⅜
Flixton Wharf	S.	119		
Boysnope Wharf (Manchester Corporation)	N.	122	29⅝	6⅜
Hulme's Bridge Ferry		122		
Barton Locks (rise 15 feet)		125–126	30⅜	5⅝
Stickens Wharf, Davyhulme (Manchester Corporation)	S.	127	30⅝	5⅜
Bromyhurst Wharf	S.	127–128	31	5
Eccles Wharf	N.	129	31½	4½
Barton Road Swing Bridge		129–130	31¾	4¼
Barton Swing Aqueduct		130	31¾	4¼
Coastwise Cattle Wharf	N.	130	31¾	4¼
Barton Wharf, South	S.	131	32	4
*Irwell Park Wharf and Lay-by	N.	133	32⅛	3⅞
*Eccles Oil Wharf	N.	134	32½	3½
Eccles Landing Stage	N.	135	32⅝	3⅜
Trafford Park, private wharves	S.	136–137	33	3
Coaling crane (25 tons)	N.	136–137	33¼	2¾
Jetty	N.	136–137	33⅜	2⅝
Coastwise cattle wharf	N.	137	33⅜	2⅝
Weaste Wharf	N.	137–138	33½	2½
Wharf (frozen meat)	N.	137–138	33½	2½
Oil wharves	S.	138	33¾	2¼
Foreign animals wharf	S.	138	33⅞	2⅛
Mode Wheel Locks (rise 13 feet)		138–139	33⅞	2⅛
Pontoon and dry docks	S.	138–139	34	2
*Grain elevator	S.	139	34¼	1¾
*Salford Quay	N.	139	34–34½	2–1½
*Trafford Wharf	S.	139–140	34¼–34⅞	1¾–1⅛
Thirty-ton crane	N.	139–140	34½	1½
*Docks Nos. 9, 8, 7, 6	N.	139–140	34¼–34⅞	1¾–1⅛
Dock Railway Swing Bridge		139–140	34¾	1¼
Cooperative Wholesale Society's Wharf	S.	140	35	1
Ferry Landing Stage	S.	140		
Trafford Road Swing Bridge		140	35	1
Dock office (temporary)	S.	140		
Throstle Nest Wharf	S.	140		
*Docks Nos. 4, 3, 2, 1	S.	142	35½–35¾	0⅝–0¼
Cornbrook Wharf	S.	142	35¾	0¼
Woden Street Foot Bridge (fixed)			36	

*Fresh water may be obtained at these places.

REGULATIONS AND BY-LAWS.

[Revised to Nov. 1, 1903.]

NAVIGATION AND DOCK REGULATIONS.

Upon receiving a copy of these regulations the captains and owners of all vessels navigating the canal must abide by and conform to them in all respects, and also satisfy all requirements of the company's officers made in conformity therewith. Captains and owners will be held responsible for all consequences that may ensue from any failure on their part to comply with these regulations.

The expression "canal" in these regulations shall be held to include the ship canal, approach channels, locks, and docks.

The expression "navigating the canal" shall be held to include entering, leaving, and mooring in, the ship canal, approach channels, locks, and docks.

1. The Manchester Ship Canal Co. do not take any charge of or assume any responsibility whatever in respect of any vessel, boat, barge, lighter, or other craft navigating the canal, all craft under such circumstances being at the sole risk of the owners, who alone are responsible for the safety and security of their vessels and moorings, and also for any damage done by their vessels or servants to the premises or property of the company, or to vessels or goods in or upon any part of the company's premises.

2. All vessels navigating the canal must have their anchors properly stowed and a strong kedge aft ready for use in case of emergency, their sails furled, all boats swung inboard, flying jib boom and jib boom rigged in, all outriggers unshipped, and yards braced fore and aft or cockbilled, so that nothing projects over the ship's side, except fenders.

3. The captain or other person in charge of every vessel must, on entering the canal, declare the particulars of the vessel and cargo, draft of water, and any other information required by the company's officers.

4. The maximum speed in the canal must not exceed 6 miles an hour, unless a special permit has been obtained from the company's general superintendent.

5. Sails must not under any circumstances be used in the canal without the permission of the dockmaster or canal superintendent.

6. Vessels must at all times be navigated with care and caution, and in such manner as will not involve risk of collision, or endanger the safety of other vessels or their moorings, or cause damage thereto, or to the banks of the canal, or to any other part of the company's property. Special care and caution must be used when approaching the locks, where the banks of the canal are under or waiting repair, when passing vessels moored or employed in dredging or other work, small craft, or workmen engaged in repairs or otherwise, under which circumstances vessels must reduce their speed to dead slow, or if necessary stop altogether.

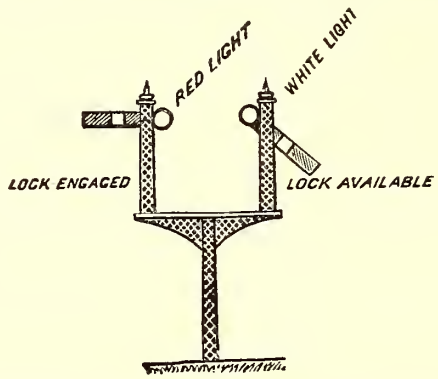
7. If the safety of any vessels or their moorings is endangered, or if damage is caused thereto or to the banks of the canal by a passing vessel, the onus shall lie upon the master of such vessel to show that she was navigated with care and caution, and at such a speed and in such a manner as directed by these regulations.

8. All vessels navigating the canal must provide and use good and sufficient ropes or warps of their own, which must be kept ready to send ashore when required. When ropes are sent on board by the company's officers they are only intended to be used in aid of the ship's own ropes, and the company do not hold themselves liable for any damage in the event of ropes breaking. Such fenders as may be necessary must be provided by the ship, and must be of such material as will not sink if lost overboard.

9. All vessels navigating the canal must carry and use proper signals in accordance with the schedule attached hereto.

10. The signals at the swing bridges consist of a black ball hoisted on a mast near the center of the bridges by day, and at night a red light is shown from the bridges midway across the canal when closed, and a green light at the side when open. If, when approaching any swing bridge, the ball signal is seen to be hoisted that will signify that the bridge is being got ready to be swung, but unless the bridge is completely open, or by night a green light is shown, no vessel must attempt to pass through. All vessels must approach the swing bridges at mod-

erate speed in case any accident should occur to the machinery whilst swinging. If the ball is not hoisted, or having been hoisted is lowered, or a red light is shown, any vessel approaching such bridge must immediately stop. If the ball should be lowered, or a red light be shown, while two vessels are approaching a swing bridge from the same direction at the same time, the bridge being open, that will indicate that the bridge is being closed against the second vessel, which must stop until the ball is again hoisted, or a green light shown.



11. Whenever a signal is against a vessel approaching any lock she must signal in accordance with the schedule attached hereto, and no vessel must make for any lock by day unless signaled to do so by the lowering of the semaphore, or by night by the changing of the red light to white, and then only for the lock for which she has been signaled.

12. No vessel must approach so near to any lock as to impede the entrance to or departure from such lock of any other vessel when the semiphore is raised or a red light is shown.

13. The lockmaster or other officer in charge shall fix the order and position in which vessels may enter or leave any lock, and his instructions shall be absolute.

14. When the stern ropes of a vessel entering a lock are ashore, the engines must not be moved ahead until she is ready to leave the lock.

15. When vessels proceeding in opposite directions are approaching one another, each vessel must be steered as closely as possible with safety to her own starboard side of the canal, so that they may pass on the port side of each other; each vessel must reduce her speed to dead slow, or, if necessary, stop the engine while passing each other, so as to insure their passing in safety. When vessels meet in the tidal portion of the canal when the tide is running in or out, the vessel proceeding against the tide must give way, or tie up if necessary, until the vessel coming with the tide or stream has passed, and when vessels meet in the nontidal portion of the canal, or in the tidal portion during slack water, the vessel bound up the canal must give way, or tie up if necessary, until the vessel coming down has passed.

16. When one vessel is following another without the intention of passing, she must not approach nearer to the leading vessel than 1 furlong or eighth of a mile.

17. No vessel must overtake another within half a mile of any lock or swing bridge. Every vessel when being overtaken must keep as far as possible to starboard of mid-channel, and if after sunset a white light must be shown over the stern. The vessel overtaking must pass on the port side of the vessel overtaken.

18. Wherever the slopes of the canal will permit, small craft must be kept entirely out of the track of seagoing vessels.

19. Whenever vessels under way require to depart from the course laid down for them in these regulations, for the purpose, for instance, of proceeding to or from any quay, wharf, works, or lock, or for any other reason, the responsibility of doing so in safety, having regard to passing traffic and to works in operation, or otherwise, will rest upon the person in charge and the owners of such vessel.

20. Special care must be taken when vessels are approaching the bridge gauges over the canal to see that there is a clear headway, and when passing down the canal no spars must be hoisted until the bridge gauge at Runcorn has been passed.

21. When dredgers are working in the canal in daylight a ball will be hoisted on the side of the dredger which is clear for vessels to pass, and this will be replaced by a white light when working at night. A red light will be shown on the side of the dredger where there is no clear passage. When moored, the dredgers will exhibit the ordinary lights by night.

22. Except by special permission in writing from the company's engineer, hopper doors must not be opened in the canal.

23. An efficient lookout must be kept on board all vessels navigating the canal, and any obstruction or danger—particularly timber or other articles observed in the canal, or damaged buoys or perches—must be reported at the first lock or swing bridge.

24. Ballast, cinders, or rubbish of any kind whatever must not be deposited in the canal or upon any portion of the company's property, except by consent of the company in writing. Rubbish, ashes, etc., must not be allowed to remain on the deck or gangway of vessels in the canal.

25. When by accident or otherwise any material of any kind whatever falls overboard or is discharged in the canal, the circumstances, quantity, nature of the material, and position must be immediately reported to the dock master, canal superintendent, or at the first lock or swing bridge.

26. Immediate notice of the sinking of any vessel must be given to the dock master or canal superintendent, and signals must be displayed as provided for in the schedule attached hereto.

27. Every vessel must be kept at all times so loaded or ballasted as to be safely navigated or moored in the canal.

28. Vessels must be moored only at such quays and other places as are provided for that purpose by the company, and, except in cases of emergency, or unless specially ordered to do so by the company's officers, no vessel must be brought up or stopped or remain moored or anchored in the fairway of the canal. When a vessel is moored in places where traffic is passing, a pennant must be hoisted at half-mast by day, and at night two white lights must be exhibited where they can be best seen, one forward and one aft, on the side of the vessel which is open to the canal. No master or other person having or taking upon himself the command or management of any vessel in the canal, nor any other person employed in or about any such vessel, shall make fast, or cause, permit, or suffer, any rope, chain, or tackle of any description to be made fast from such vessel to the pillars or any other part of any shed, or to the rails, railway wagons, or to any other property of the company, excepting the bollards, mooring posts, or rings specially provided for the purpose. When a vessel is moored the engines must not be set in motion without the express permission of the dock master or canal superintendent, nor until a suitable lookout has been first placed fore and aft.

29. A competent watchman must be in charge both day and night on board every vessel in the canal, except small boats, and the latter must be moored clear of the traffic.

30. Vessels must be removed on the first intimation from the dock master or canal superintendent; and masters or other persons in charge and owners of vessels must obey the directions of, and must not offer any obstruction to, such officers as to the mooring, unmooring, or moving of any vessel, or in regulating the position for loading and discharging of any vessel, and the quay space to be occupied by them; and no vessel must be removed from one berth to another without the express permission of the dock master. All vessels must be moved by the persons in charge and their crews, under the direction of the dock master, his assistants, or deputies.

31. No vessel may tow any other vessel unless licensed or authorized by the company to do so; tow lines must not exceed 50 feet within the canal, and the stern of the hindmost vessel towed must not be distant more than 500 feet from the bow of the vessel towing when between Eastham and Mode Wheel Locks and not more than 400 feet when above Mode Wheel Locks. Two trains of vessels towed must not exceed 40 feet in width, and must be properly secured by breast ropes. When the vessels are towed in single line, the tow rope must be made fast on the port bow of the vessels towed, and no vessel, barge, or craft of any description must be

moved in the fairway of the canal without the assistance of a tug or her own propelling power without the special permission of the dock master or canal superintendent.

32. No person shall have or keep any fire, lighted candle, or lamp, in any portion of the docks or in any vessel in the canal, unless such candle or lamp be at all times inclosed in a lantern, or unless such fire consume only coal or coke, and be safely secured. When a fire is observed to have broken out on board any vessel, an alarm should be raised by ringing a bell on board such vessel, and at the same time an alarm given through one of the Gamewell fire alarms, which are fixed up in various places about the docks. Every vessel must have on board hose pipe of sufficient length and section, in good working order, and capable of being immediately attached to the force pump, for the purpose of extinguishing fire. When a fire is observed to have broken out in any warehouse, shed, or elsewhere on the company's property, the nearest Gamewell fire alarm should be immediately made use of. Signaling a fire through a Gamewell fire alarm notifies the position of the fire simultaneously to both the company's dock fire office and also the fire office of the Manchester Corporation in the city.

33. No ship or boat laden wholly or in part with any explosive substance will be allowed to enter the canal without the special permission of the company in writing.

34. No timber or other merchandise must be discharged into the canal without the consent of the dock master or canal superintendent.

35. No master or other person in charge of any vessel lying in the canal shall permit such vessel to be discharged or loaded, or shall permit such vessel or her masts, spars, or tackle to be repaired, in such manner as to allow any substance to fall into the canal, or without providing a canvas or other protection, if necessary, so secured from the side of such vessel during the whole of the time occupied by such discharge, loading, or repairs, as effectually to prevent any substance from falling into the canal.

36. It is the duty of the owner of every vessel to provide ladders or stages, and of the officer in charge of the vessel to see that the same are securely placed and duly protected so as to form a safe gangway on board or over such vessel, and that they are properly replaced whenever it is necessary to shift the same, or alter the moorings; and the company are not responsible for the sufficiency or security of any ladder or stages which may be lent to vessels for such purpose.

37. Cargo must not be deposited near the edge of the quays, and no obstacle of any kind must be allowed to interfere with the free and safe use of the quays, mooring posts, bollards, hydrants, or hydraulic connections.

38. Privies and urinals are provided for the convenience of persons using the docks. All closets on board any vessel or craft must be kept closed during the whole time such vessel or craft is in the canal.

39. Dogs must be properly secured by the person in charge of them, or otherwise responsible for their control. Ferocious animals, or birds, or dangerous reptiles will not be permitted on board any vessel, barge, lighter, or other craft, or upon any of the company's premises, unless properly secured.

40. Smoking is strictly prohibited upon any part of the docks, wharves, or premises of the company, except at places specially provided. Smoking upon any vessel, barge, lighter, or other craft is also prohibited in respect of any vessel loading or discharging cargo damageable by fire.

41. All persons are prohibited from writing upon, soiling, defacing, marking, or injuring any of the sheds, barricades, railings, fences, posts, or any other part of the premises of the company in any way whatever.

42. No vehicle of any description and no horse or beast of burden will be allowed to remain unattended upon any of the company's roads or quays, or for a longer time than is necessary for the loading or unloading of goods, or for taking up or setting down passengers.

43. No person other than an authorized officer of the company shall make use of any crane, jigger, hydraulic lead, hydraulic lift, hydraulic levers at the docks or locks, or any other machinery or working appliances of the company, and any other person interfering or tampering with any such machinery or working appliances will be liable to prosecution.

44. No person will be allowed to load or discharge, or to assist in loading or discharging, vessels in the docks, or to handle traffic upon the quays or in the sheds, unless authorized to do so, or employed by the dock traffic superintendent of the company.

45. No goods will be allowed to be removed from the premises of the company until an authorized pass has been delivered in respect of them.

46. The master or other person in charge must give reasonable notice to the dock master or canal superintendent of the time when his vessel is intended to leave her berth.

47. Any person who assaults, resists, obstructs, or impedes any officer of the company, in the execution of his duty, or disobeys his lawful orders, or uses abusive or offensive language, or aids or incites others to do so, will be liable to prosecution.

The officers of the company are hereby instructed to report every offense against any of the foregoing regulations.

SCHEDULE OF SIGNALS.

Reason for signal.	During the day, between sunrise and sunset.	During the night, between sunset and sunrise. (Lights in accordance with the provisions for avoiding collisions at sea.)
When approaching other vessels, boats, or rafts.	Whistle	Whistle.
When overtaking another vessel with intention to pass.	.....do	Do.
If obliged to stop when another vessel is following.	3 blasts of whistle—1 short, 1 long, and 1 short blast.	3 blasts of whistle—1 short, 1 long, and 1 short blast.
When approaching a lock or swing bridge and requiring to pass through.	Whistle—approaching from Manchester, 1 long and 1 short blast of whistle; from Eastham, 1 long blast of whistle; but whistle not to be sounded if semaphore lowered at lock or ball hoisted at swing bridge.	Whistle—approaching from Manchester, 1 long and 1 short blast of whistle; from Eastham, 1 long blast of whistle.
During fog, mist, or falling snow	Comply with the rule of the road	Comply with the rule of the road.
Vessels aground or disabled	3 black balls or shapes in a vertical line one over the other, not less than 3 feet apart, to be placed on the mast where they can be seen by those navigating the canal both ways; bell to be rung on the approach of any other vessel.	3 red lights in globular lanterns in a vertical line one over the other, not less than 3 feet apart, to be placed on the mast where they can be best seen by those navigating the canal both ways; 1 bright circular light aft; bell to be rung on the approach of any other vessel.

BY-LAWS FOR REGULATING THE PASSAGE OF VESSELS THROUGH THE ESTUARY LOCKS OF THE MANCHESTER SHIP CANAL AT WESTON AND RUNCORN, AND ACROSS THE SAID CANAL BETWEEN THE WESTON MERSEY LOCK AND THE WESTON POINT DOCKS, AND BETWEEN THE BRIDGEWATER LOCK AND THE RUNCORN DOCKS.

1. Vessels passing up or down the canal when traffic is crossing the canal to or from the estuary locks shall reduce speed to dead slow, proceed with caution, and be otherwise kept well under control, and if necessary stop; the steamer or tug giving timely notice of her approach by one long whistle, to be sounded when not less than 500 yards off any estuary lock, to be repeated at short intervals until the lock is passed.

2. At all times when the Mersey tide is nearly level with either the canal or Runcorn or Weston Docks, vessels passing up or down the canal shall reduce their speed when passing the said docks or locks, so as not to injure the dock or lock gates by causing them to open or shut by reason of the wash.

3. No vessel shall make for any lock against the signal shown by the lock master, who, when the tide serves, shall always signal for vessels to approach by the lowering of a semaphore by day or by a white light by night, unless at a time or under circumstances when the approach of such vessels would involve danger.

4. Vessels leaving or entering the estuary shall do so in the order indicated at the time by the lock master, subject to the rights of precedence given by by-laws Nos. 6 and 7.

5. Persons in charge of vessels entering, leaving, or passing through the locks, or when moored within the locks, or alongside of the lock walls, shall in all matters appertaining thereto follow the direction of the lock master.

6. All Weaver navigation traffic destined for the Weston Mersey Lock, whether inward or outward bound, shall have whatever precedence may be necessary to enable it to pass between the Weaver navigation and the Mersey, or vice versa, on the same tide.

7. All Bridgewater navigation traffic destined for the Bridgewater Lock, whether inward or outward bound, shall have whatever precedence may be necessary to enable it to pass between the Runcorn Docks and the Bridgewater Canal entrance and the Mersey, or vice versa, on the same tide.

8. In the case of inward-bound vessels, on every occasion where vessels or barges waiting at or in the Weston Mersey Lock, or at or in the Bridgewater Lock, to be passed through can be so locked through before other inward traffic in sight can reach the respective lock, the lock master at that lock shall pass the same through the lock forthwith.

9. In the case of outward-bound vessels, on every occasion where vessels or barges waiting at or in the Weston Mersey Lock to be passed through can be so locked through before other outward traffic in sight can reach the lock, the lock master shall pass the same through the lock forthwith.

10. The canal company shall make provisions for allowing vessels coming from the Weaver navigation to moor in the canal at any time for the purpose of being marshaled, in order to expedite their passage into the Weston Mersey Lock, but so as not to interfere with the working of the canal.

11. Any person having charge of any vessel lying on either side of the canal, in the neighborhood of the Weston Mersey Lock and the Weston Point Dock, or the Bridgewater Lock and the Runcorn Docks, and intending to cross the canal, shall not cross the canal until directed to do so by the officials in charge (or other authorized person) regulating the traffic on that side of the canal where the vessel is lying, but such directions shall be given as will maintain the precedence assigned to the Bridgewater navigation and Weaver navigation traffic.

12. The clerk, engineer, pier master, clerk of works, or any person duly authorized by the River Weaver trustees shall have power to stop, detain, moor, unmoor, place, move, or remove any vessel lying in the canal alongside the trustees' property, from the boundary of the trustees' property immediately north of the Delamere entrance to the boundary of such property south of Weston Marsh Lock, provided that in so doing they do not interfere more than necessary with the traffic on the canal.

13. If through noncompliance with any of the foregoing conditions, or through any willful action of those in charge of the Weston Mersey Lock, any Weaver navigation vessels or barges, or of the Bridgewater Lock, any Bridgewater navigation vessels or barges outward bound are detained, and in consequence lose the tide, the same shall have the right to proceed down the ship canal to Eastham free of any charge; and any vessels or barges for the said navigations detained inward through a similar cause shall have the right to lie in the canal free of any charge till the next tide allows them to enter into their respective docks.

14. The canal company are not bound to provide any ropes, fenders, or other appliances for assisting vessels, but if and when the company's appliances are used, the same are used by vessels at their owners' risk, and the failure of such appliances does not exempt the owners of any vessel from liability for damage done to the company's property in consequence.

15. The Weston Mersey Lock is available to vessels the draft of which does not exceed 3 feet 6 inches less than the water indicated for the tide on the old dock sill according to Holden's Liverpool time-table.

Given under the common seal of the Manchester Ship Canal Co. this 21st day of June, 1895.

JAMES W. SOUTHERN,
JOSEPH LEIGH,
Directors.

[SEAL.] A. H. WHITWORTH, *Secretary.*

In pursuance of the powers vested in them by the Manchester Ship Canal Act of 1895 the Board of Trade hereby signify their confirmation of the above by-laws.

By order of the Board of Trade this 3d day of August, 1895.

T. H. W. PELHAM, *Assistant Secretary.*

PILOTAGE BY-LAWS FOR THE REGULATION OF PILOTS FOR THE PORT OF MANCHESTER, AND OF MASTERS AND MATES OF VESSELS HOLDING PILOTAGE CERTIFICATES.

At the court at Windsor, the 21st day of November, 1895. Present, the Queen's most excellent majesty in council.

Whereas, by the five hundred and eighty-second and five hundred and eighty-third sections of the Merchant Shipping Act of 1894 it is enacted that a pilotage authority may, by by-law made under Part X of that act, do all or any of the things specified in the said section; but that a by-law so made shall not take effect until it is submitted to Her Majesty in council and confirmed by order in council; and

Whereas, the Manchester Ship Canal Co., being the pilotage authority for the port of Manchester, have made and submitted for confirmation by Her Majesty certain by-laws as set forth in the schedule hereto annexed; and

Whereas, it has been made to appear to Her Majesty that the proposed by-laws are proper and reasonable; and

Whereas, the provisions of section 1 of the Rules Publication Act of 1893 have been complied with: Now, therefore,

Her Majesty, by virtue of the powers vested in her by the Merchant Shipping Act of 1894, and by and with the advice of her privy council, is pleased to approve of and confirm the said by-laws as set forth in the schedule hereto annexed.

C. L. PEEL.

SCHEDULE.—BY-LAWS.

1. The following by-laws shall commence and take effect on the 1st day of December, 1895.

2. In the construction of these by-laws "the company" shall mean the Manchester Ship Canal Co., the expression "the directors" shall mean the directors for the time being of the Manchester Ship Canal Co., and "the canal" shall mean the Manchester Ship Canal.

3. Pilotage upon the canal is not compulsory, but no pilot, except qualified and licensed as hereinafter mentioned, shall be permitted to navigate, conduct, or move any vessel within the canal, docks, and basins of the company.

4. The company may, if they deem it expedient so to do, examine any person (or persons) who shall be desirous to act as a pilot; and every person who shall be approved of by the company shall receive a license in writing, signed by the company's secretary, stating that he is duly qualified to act as a pilot on the canal, and also setting forth the name, age, stature, complexion, and place of abode of the person so licensed.

5. Every license granted by the company shall expire on the first day of the month of September which shall first happen after the granting thereof; and for the license which shall be granted to any person upon his first admission as a pilot, there shall be paid to the company the sum of £2 2s., and for the second and every subsequent license which shall be granted to such person the sum of £1 1s.

6. Every licensed pilot shall exhibit his license to the master of the vessel, and give his name and address and behave with strict sobriety and respect, and use his utmost care and diligence to conduct the vessel to her destination safely, and without damage to any vessel or other property; and he shall obey and execute all lawful orders given by the company's superintendents, dock masters, and officials relative to the locking, towing, transporting, or removing of any vessel under his charge, and he shall not, when the signal is against him, bring or attempt to bring any vessel into any lock, dock, or basin without an order in writing from an authorized official of the company.

7. Every pilot to whom a license has been granted shall provide himself with a flag of the usual dimensions and of two colors, the upper horizontal half red and the lower horizontal half white, and on taking charge as pilot of any vessel, and so long as he remains in charge, he shall cause his flag to be hoisted on board such vessel where it may be most conspicuously seen, and shall keep this flag continually flying until he is discharged or relieved by another pilot.

8. Every pilot shall, when on duty, always have with him a good watch, a tide table, copy of the company's by-laws, his license, and his flag.

9. Every licensed pilot shall, before leaving any vessel piloted by him either inward or outward, obtain from the officer in command of such vessel a certificate[1] of his services, and shall, upon landing, report himself to the company's superintendent or official in charge at such landing, and deliver up to such superintendent or official every such certificate and all moneys received by him.

10. No person to whom a pilotage license shall be granted by the company shall add to or in any way alter such license or make or alter any indorsement thereon, nor shall at any time lend such license.

11. A licensed pilot shall not, without the company's consent, demand or receive in respect of any services any payment either in excess of or less than the amount which he shall under any resolution or regulation of the company for the time being in force be entitled to receive.

12. Whenever any licensed pilot shall observe any alteration in any of the banks or the depth of water in the canal, or that any buoys, beacons, or lights have been driven away, broken down, damaged, or are out of place, or any circumstances affecting the safety of the

[1] The certificate referred to is No. 397, which is filled out by the pilot, signed by the master of the vessel, and is delivered or posted to the proper canal official. Certificate No. 398 is filled out and signed by the master of the vessel and is retained by the pilot as a record. The two certificates are as follows:

NOTE.—This Certificate must he filled up by the Pilot, and the total amount of Pilotage inserted therein before it is signed hy the Master and Pilot of the Vessel. It must afterwards be stamped and posted by the Pilot, or given up by him at any Lock or Station of the Company for transmission to the Dock Office.

SHIP CANAL PILOTAGE.

Vessel's Name.....*Nationality*.....
Reg. Tonnage.....*Loaded or Ballasted*.....
Draught.....*feet*.....*inches. Date of service*.....191..
Piloted from.....*to*.....
Total amount of Pilotage due, £.....
Detention (If any, state reason thereof and time occupied.).....*Time*....*hrs. Amount, £*.....
Owner or Agent liable for Pilotage.....
Signed.....*Master.*
.....*Pilot.*

Charges for Pilotage outside of the Canal must not be included in this Certificate.

FULL PARTICULARS OF ANY CHARGE FOR DETENTION MUST ALWAYS BE STATED.

Gratuities must not be given or received, as this would be an infringement of the Company's Pilotage Bye-law No. 11 and render the Pilot liable to a heavy penalty.

NOTE.—This Certificate is to be filled up and signed hy the Master of the Vessel, and returned to the Pilot.

MANCHESTER SHIP CANAL PILOTAGE.

Vessel's Name.....*of*.....
Draught.....*feet*.....*inches.*
Reg. Tonnage.....*Loaded or Ballasted*.....
Bound from.....*To*.....
Piloted from.....*To*.....
Extra Services.....
Date.....*191*....
Pilot's Name.....
Total amount of Pilotage due, £.....
Owner or Agent.....
.....*Master of Vessel Piloted.*

navigation of the canal, he shall forthwith send correct written information thereof to the manager of the company.

13. Whenever any accident shall have happened to or been caused by any vessel while in charge of a licensed pilot, such pilot shall, immediately after leaving the vessel, report the facts of such accident, so far as he knows them, to the nearest canal superintendent.

14. Any licensed pilot losing his license shall forthwith give notice thereof to the company's secretary, stating the circumstances under which the license was lost, and the company's secretary shall, unless he shall be satisfied that the loss has been caused by the pilot's misconduct, cause to be issued to such pilot a duplicate license in a form to be approved by the company. For a duplicate license a licensed pilot shall pay to the company such a sum, not exceeding £2 2s., as the company may direct in each case.

15. All pilotage rates[1] shall be collected by the company and paid to the pilots who earn the same, less a reasonable deduction for the cost of collection. Such pilotage rates shall be as follows:

An initial fee shall be paid for each vessel when requiring pilotage service entering or leaving the canal, according to the net registered tonnage.

	£	s.	d.
300 tons and under	0	10	0
600 tons and under	1	0	0
1,200 tons and under	1	10	0
All over 1,200 tons	2	0	0

and in addition thereto a sum at the rate of 1 shilling per mile or portion of a mile for the distance navigated. Vessels in ballast shall pay the full initial fee, but only half of the mileage rate.

16. When pilotage service is rendered to a vessel in the canal, but when not entering or leaving the canal, one-half the above-named initial fee is to be charged in addition to the mileage rate of 1 shilling per mile.

17. In case any licensed pilot shall refuse to pilot any inward or outward bound vessel upon the request of the master thereof, or in case it shall be proved to the satisfaction of the company's directors that any pilot shall in any manner have failed in or neglected his duty as a pilot, or in any manner acted contrary to any of these by-laws, or if any pilot shall refuse to obey any summons of the company's directors to appear before them, or to obey any order of the directors, the company may recall the license granted to such pilot, and declare the same to be void, or may suspend the same for such time as they shall think proper.

18. Every person offending against or contravening any of the preceding by-laws shall, for every such offense, forfeit and pay a sum not exceeding £5.

19. If any person other than the master or mate shall pilot any vessel into, or out of, or along the canal, docks, or basins of the company without having been first duly licensed by the company to act as a pilot, or after the expiration of his license, and before the same shall have been renewed, he shall for every such offense be liable to a penalty of not exceeding £20.

REGULATIONS FOR THE USE OF FIRES AND NAKED LIGHTS FOR THE REPAIR OF VESSELS IN THE DOCKS.

1. No person shall use any fire for heating iron or smith's work on board any vessels in any of the docks without the written permission of the dock master being previously obtained, and unless such fire shall be used or kept at all times in a portable iron forge on the upper deck and away from the hatches of the vessel, but under special conditions it may be allowed on the 'tween decks of an iron vessel; the fire and forge are to be well and sufficiently secured under the supervision and to the satisfaction of one of the company's police officers, and for whose attendance a charge shall be made, but the company will be in no way responsible for such fire or any damage caused thereby.

[1] See also "Schedule of ships' dues and other charges," Appendix VI of report upon Panama Traffic and Tolls.

2. No person shall use any fire for heating bent plate, or stem, or any part of the vessel's hull or structure without the written permission[1] of the dock master is previously obtained, and stating in which part of the docks such repairs are to be proceeded with. Such fires are to be under continued supervision of the company's police, for whose services a charge shall be made, but the company will not be responsible for such fires or any damage caused thereby.

3. No master, mate, or other person in charge of a vessel, barge, lighter, or craft loading or unloading any cotton, tar, pitch, resin, hemp, jute, turpentine, oil, hay, straw, shavings, faggots, or other combustible goods shall, without previous permission in writing of the dock master, permit or suffer any person to have, nor shall any person without such permission have, a fire or naked light on deck when the hatches are off, or have any other thing near to or amongst such combustible goods, whereby the security of the same is endangered.

4. No person shall use any fire on board any vessels for fumigating or drying the vessels, or drying the bread tanks, or for burning off paint, without permission of the dock master, and every such fire shall be placed, secured, and used to the satisfaction of the company's police officer, who shall remain on board the vessel whilst the fire is being used, and for whose attend-

[1] Application for a permit to use a fire is made on form No. 1166 by the master of the vessel. Permission is given by the dockmaster on form No. 1497. They are as follows:

MANCHESTER SHIP CANAL.

MANCHESTER,
..... 190

Application for Permit for Fire.

To the DOCKMASTER, MANCHESTER.

SIR: For the purpose of repairs on board ..... viz:

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I shall be glad if you will grant a permit for a forge-fire or any other safe means placed in.....

.....

.....

for heating iron necessary for repairs.

I will take every precaution, and make every provision necessary against the spread of such fire; and hold myself and owners responsible for any loss or damage that may arise, directly or indirectly, from such fire, and undertake to strictly comply with the Ship Canal Company's Fire Regulations.

Yours truly,

.....

Master or Officer in charge,

S.S. .....

MANCHESTER SHIP CANAL.

DOCK OFFICE, MANCHESTER,
..... 190

Fire Permit.

To the master or officer in charge of S.S. .....

In reply to your ..... request of ..... for permission for a fire to be used on your steamer, for the purpose of effecting the undermentioned repairs, viz:

such permission is hereby granted on condition that every precaution is taken by you or some one on your behalf, to prevent the spread of such fire, and that the portable forge, or other safe means used for containing the fire, shall be kept as far as possible from hatchways, cargo, or any inflammable material, and that ample means are, during the use of such fire, kept at hand, available for instant use in extinguishing a fire.

It is also hereby understood that this permit is granted on the understanding that the owners of the steamer named herein accept all risk and responsibility in respect of the use of the fire, and that the canal company do not accept any risk whatever in regard thereto.

.....

Dockmaster.

NOTE.—The company's regulations provide that fires used both on the dock premises, and on board vessels in the docks in connection with repairs to vessels, are to be under the supervision of one of the company's police officers for whose attendance a charge will be made.

ance a charge shall be made, but the company will not be responsible for such fire or any damage caused thereby.

5. No person shall use any fire in any shed on the docks for heating rivets, water, tar, or for melting lead for vessel's purposes, but the same can be used on an open quay, and at a reasonable distance from the edge of the quay and from combustible goods, after permission has been obtained from the dock master. The fire is to be put under the supervision of the company's police officer, for whose attendance a charge will be made, but the company will not be responsible for such fire or any damage caused thereby.

6. Whenever there is fire permitted for special purposes there should be provision made to extinguish same by having a water hose laid ready, or buckets and water in them at hand, etc.

7. No person shall use naked lights in any part of a vessel, except the engine room, stoke hold, or shaft funnel, without permission from the company.

REGULATIONS FOR THE NAVIGATION OF THE SHIP CANAL BY VESSELS CARRYING PETROLEUM IN BULK, AND FOR THE DISCHARGE OF PETROLEUM IN BULK IN THE SHIP CANAL.

1. Previous to the discharge of any petroleum a declaration[1] must be signed by the owners or the captain of the vessel stating that the oil does not flash under 73° F.

2. An application[1] in writing must be made by the importer to the harbor master for permission to pump the oil from the vessel into the pipes leading to the storage tanks, and the applicant must indemnify the Manchester Ship Canal Co. against all losses, damages, costs, or expenses which they may incur or become liable for by reason of the granting of any such permission. No oil must be allowed under any circumstances to leak or flow into the canal or on to the quay.

3. No fires or lights shall be allowed on board the vessel during the time of discharging, except such necessary fires in the engine room for generating steam for pumping the oil as the harbor master may from time to time permit; no smoking shall be allowed on board the vessel or any lighter lying alongside or on the quay during such time, and no matches except safety matches shall be on board.

4. Every possible precaution must be taken, both by the master of the vessel and by the importer to prevent risk of fire or explosion. Notice in writing must be given by the master of the vessel to the harbor master previous to water being pumped into the tanks of the vessel.

5. The vessel shall not, whilst in the canal, be left without a sufficient crew on board. No persons, other than the crew and such other persons as shall be employed or engaged by the importer or by the master or owner of the vessel in connection with the discharge of the cargo, shall be allowed on board the vessel or on the quay alongside.

6. An officer may be sent by the harbor master to watch the carrying into effect of these regulations, and may remain in attendance until the cargo has been duly discharged.

7. Notices in writing must be given to the harbor master when it is proposed to ventilate the tanks after the oil has been pumped therefrom, and such notice shall state the mode in which it is proposed to effect such ventilation.

8. No lighter or other craft shall, except with the permission of the harbor master, lie alongside any vessel during the discharge of her cargo, and if such permission is given no lights[2] or fires shall be allowed on board such craft.

9. Every vessel having petroleum on board shall keep conspicuously exhibited, from sunrise to sunset, a red flag.

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[1] See page 552.

[2] See pages 553–554.

BY-LAWS MADE BY THE MANCHESTER SHIP CANAL CO. FOR REGULATING THE FOREIGN-ANIMALS TRAFFIC IN THE HARBOR AND PORT OF MANCHESTER.

1. Prior to the entry into the ship canal of any vessel carrying foreign animals a printed copy of these regulations shall be given to the master of such vessel by the pilot of the ship, and also by the lock master at Eastham.

2. So long as any vessel carrying foreign animals remains in the ship canal, and until such animals have been discharged, such vessel shall fly, as a distinguishing flag, the code flag "K" immediately below the pilot flag.

3. During the passage through the ship canal or locks of any vessel carrying foreign animals, and until the arrival of such vessel at the foreign-animals wharf, no person shall leave such vessel.

4. A vessel carrying foreign animals shall not be permitted to enter or use any lock so long as the same is occupied by any other vessel other than a tugboat engaged in assisting the vessel carrying foreign animals to her destination; and so long as any vessel carrying foreign animals is in any lock, no other vessel shall be permitted to enter or use the same.

5. A vessel carrying foreign animals shall not be permitted to enter or use any lock so long as any vessel carrying animals other than foreign animals is in one of the same set of locks; and so long as any vessel carrying foreign animals is in any lock no vessel carrying animals other than foreign animals shall be permitted to enter or use one of the same set of locks.

6. If any pilot, lock master, or other servant of the company infringe any of these regulations, or fail to enforce the same, he will be liable to immediate suspension and to be dismissed from the company's service.

7. The expression "foreign animals" in these regulations means cattle, sheep, or swine imported from any country or place out of the United Kingdom.

THE MANCHESTER SHIP CANAL COMPANY,
A. H. WHITWORTH, *Secretary*.

DECEMBER 4, 1893.

The Board of Trade hereby signify their confirmation of the above by-laws.
By order of the Board of Trade this 8th day of December, 1893.

C. CECIL TREVOR, *Assistant Secretary*.

NOTICES TO MARINERS AND PILOTS ISSUED BY MANCHESTER SHIP CANAL COMPANY 1902–1911.

REGULATIONS FOR THE USE OF THE LOCKS.[1]

Every steamer navigating the ship canal must strictly obey the following regulation when entering any lock:

Every steamer using a lock must be brought up in the manner described below, and is hereby prohibited from again using her engines after being brought up until the gates in front of her are open and the lockmaster gives the order for the steamer to proceed out of the lock. When a vessel has a tug ahead it may assist her in proceeding along the lock after being brought up but when a steamer has no tug ahead she must be warped into position along the lock from the position in which she has been brought up.

Large locks.—When a steamer uses one of the large locks either in going up or down the the canal she must be brought up so that her bows shall not be more than 300 feet beyond the pierhead which she passed on entering the lock.

Small locks.—When a steamer going up the canal uses one of the small locks she must be brought up so that her bows shall not be more than 200 feet beyond the large island pierhead which she passed on entering the lock.

[1] See notices of Feb. 1, 1904; Apr. 13, 1905; and Nov. 25, 1905.

When a steamer going down the canal uses one of the small locks she must be brought up alongside the pier on the starboard side of the lock so that her bows shall not be more than 200 feet beyond the large island pierhead which she passed on entering the lock.

By Order of the Board of Directors.

Manchester, *December 19, 1902.*

TRANSMISSION OF ORDERS TO ENGINE ROOM.

Whenever a steamer is navigating any portion of the ship canal or docks, every order telegraphed to the engine room must be at the same moment conveyed verbally to the engine room.

For this purpose a man must always be stationed below the steamer's bridge, and every order must be given to him simultaneously with the telegraphic order loud enough for the man to hear, and he must instantly repeat the order in a voice loud enough to be distinctly heard in the engine room.

No infringement of this regulation can be permitted for any reason whatsoever.

By Order.

Dock Office, Manchester, *December 13, 1902.*

LEADING LIGHTS ON THE CANAL.

Please note that with a view to assisting vessels regularly navigating the canal at night time, the canal company have provided lamps showing white lights to act as leading lights to enable those in charge of steamers passing both up and down the waterway on and after the 1st proximo, to pick up the various points along the canal.

The points at which the lights have been fixed are as follows:

One on south side of canal between Nos. 68 and 69 per chart, opposite Wiggs's Works, Runcorn.

One on north side of canal at No. 76 per chart (Randle's Sluices).

One on south side of canal between Nos. 100 and 101 per chart, near Rixton Junction.

One on north side of canal at No. 104 per chart near to Mill Bank.

By order.

E. Latimer, *General Superintendent.*

Dock Office, Manchester, *November 30, 1903.*

NEW JETTY—BARTON LOCKS.

Notice is hereby given that a leading jetty, 200 feet in length, has now been erected on the north side of the canal at the upper end of the 65-foot lock at Barton, alongside which all outward-bound vessels must be brought up, and the steamer's engines must not be again set in motion until the vessel is ready to leave Barton after having been lowered down in the lock and the lower gates opened.

All vessels after having been so brought up at the jetty must be warped into the lock, or, if assisted by tugs, be towed into the lock, but only at such a speed as will enable the vessels to be brought up at any moment with the ship's own ropes.

This notice cancels the notice given on the 19th of December, 1902, so far as regards the use of the 65-foot lock at Barton by vessels outward bound.

By Order of the Board of Directors.

Manchester, *February 1, 1904.*

NEW JETTY—IRLAM LOCKS.

Notice is hereby given that a leading jetty, 264 feet in length, has now been erected on the north side of the canal at the upper end of the 65-foot lock at Irlam, alongside which all outward-bound vessels must be brought up, and the steamer's engines must not be again set in motion until the vessel is ready to leave Irlam after having been lowered down in the lock and the lower gates opened.

All vessels after having been so brought up at the jetty must be warped into the lock, or, if assisted by tugs, be towed into the lock, but only at such a speed as will enable the vessels to be brought up at any moment with the ship's own ropes.

This notice cancels the notice given on the 19th of December, 1902, so far as regards the use of the 65-foot lock at Irlam by vessels outward bound.

By Order of the Board of Directors.

Manchester, *April 13, 1905.*

NEW JETTY—LATCHFORD LOCKS.

Notice is hereby given that a leading jetty, 264 feet in length, has now been erected on the north side of the canal at the upper end of the 65-foot lock at Latchford, alongside which all outward-bound vessels must be brought up, and the steamer's engines must not be again set in motion until the vessel is ready to leave Latchford after having been lowered down in the lock and the lower gates opened.

All vessels after having been so brought up at the jetty must be warped into the lock, or, if assisted by tugs, be towed into the lock, but only at such a speed as will enable the vessels to be brought up at any moment with the ship's own ropes.

This notice cancels the notice given on the 19th of December, 1902, so far as regards the use of the 65-foot lock at Latchford by vessels outward bound.

By Order of the Board of Directors.

Manchester, *November 25, 1905.*

NEW SIGNALS AT EASTHAM LOCKS TO INDICATE WHEN THE WATER IN THE RIVER MERSEY AND IN THE SHIP CANAL IS ON THE SAME LEVEL.

Notice is hereby given that on and after the 8th of January, 1907, whenever the water in the River Mersey and in the ship canal is on the same level and the lock gates are open the following signals will be exhibited:

At night a fixed green light placed between the present signal lights, but 6 feet higher than those lights, will be exhibited on both the north and the south ends of the Eastham locks.

By daylight a disk will be exhibited instead of the green light in the same position on both the north and south ends of the locks.

These additional signals will in no way affect or interfere with the working of the present semaphore signals, which will be operated as hitherto.

By order:

E. Latimer, *General Superintendent.*

Dock Office, Manchester, *January 2, 1907.*

SIGNALS AT EASTHAM SHEER LEGS.

Notice is hereby given that on and after the 12th of April, 1909, the following signals will be exhibited at the sheer legs at Eastham whenever it is working, viz:

By day, three balls one over the other, 3 feet apart; and by night, three red lights in similar position.

Whenever either of these signals is shown all vessels approaching the sheer legs must reduce their speed and pass the vessel lying at the sheer legs at dead slow speed, or, if ordered verbally to do so, stop altogether.

By order:

E. LATIMER, *General Superintendent.*

DOCK OFFICE, MANCHESTER, *April 8, 1909.*

GUIDING LIGHTS ON THE CANAL.

Notice is hereby given that the canal company have provided two beacon lamps showing white guiding lights to assist those in charge of steamers passing up and down the waterway after dark to pick up the various points along the canal between Eastham and Ellesmere Port, and such lights will come into use on the 9th instant.

The points at which the lights have been fixed are as follows:

On the west side of canal near to No. 6, per chart at Hooton Wharf.

On the east side of canal near to No. 9, per chart at Mount Manisty.

By order:

E. LATIMER, *General Superintendent.*

DOCK OFFICE, MANCHESTER, *October 8, 1909.*

NOTICE TO MARINERS.

LIGHT ON NO. 14 DOLPHIN, WEST SIDE OF ENTRANCE CHANNEL AT EASTHAM LOCKS.

Notice is hereby given that owing to the reconstruction of No. 14 dolphin, situate on the west side of the approach channel to the Eastham Locks, the white light now exhibited on such dolphin will, from and after the 16th July instant, be placed and exhibited on No. 15 dolphin until further notice.

By order:

E. LATIMER, *General Superintendent.*

DOCK OFFICE, OLD TRAFFORD, *July 12, 1910.*

NOTICE TO VESSELS LOADING OR DISCHARGING AT THE UNITED ALKALI CO.'S WIGG WORKS, OLD QUAY, RUNCORN.

Attention is directed to clause No. 46 in the book of regulations and by-laws of the Manchester Ship Canal Co., which reads as follows:

> The master or other person in charge must give reasonable notice to the dock master or canal superintendent of the time when his vessel is intended to leave her berth.

And notice is hereby given that the captain, pilot, or other officer in charge of any vessel lying at this wharf must not leave her berth for the purpose of turning round or proceeding either up or down the canal without first advising the company's canal superintendent at Runcorn or the company's official at the Old Quay Swing Bridge.

By order:

E. LATIMER, *General Superintendent.*

DOCK OFFICE, MANCHESTER, *March, 1911.*

NOTICES REGARDING THE HANDLING OF PETROLEUM.

Regulations for the Navigation of the Ship Canal by Vessels Carrying Petroleum in Bulk, and for the Discharge of Petroleum in Bulk in the Ship Canal.

1. Previous to the discharge of any petroleum, a declaration must be signed by the owners or the captain of the vessel stating that the oil does not flash under 73° F.

2. An application in writing must be made by the importer to the harbor master for permission to pump the oil from the vessel into the pipes leading to the storage tanks, and the applicant must indemnify the Manchester Ship Canal Co. against all losses, damages, costs, or expenses which they may incur or become liable for by reason of the granting of any such permission. No oil must be allowed under any circumstances to leak or flow into the canal or on to the quay.

3. No fires or lights shall be allowed on board the vessel during the time of discharging, except such necessary fires in the engine room for generating steam for pumping the oil as the harbormaster may from time to time permit; no smoking shall be allowed on board the vessel or any lighter lying alongside or on the quay during such time, and no matches except safety matches shall be on board.

4. Every possible precaution must be taken, both by the master of the vessel and by the importer, to prevent risk of fire or explosion. Notice in writing must be given by the master of the vessel to the harbormaster previous to water being pumped into the tanks of the vessel.

5. The vessel shall not, whilst in the canal, be left without a sufficient crew on board. No persons, other than the crew and such other persons as shall be employed or engaged by the importer, or by the master or owner of the vessel in connection with the discharge of the cargo, shall be allowed on board the vessel or on the quay alongside.

6. An officer may be sent by the harbor master to watch the carrying into effect of these regulations, and may remain in attendance until the cargo has been duly discharged.

7. Notice in writing must be given to the harbor master when it is proposed to ventilate the tanks after the oil has been pumped therefrom, and such notice shall state the mode in which it is proposed to effect such ventilation.

8. No lighter or other craft shall, except with the permission of the harbor master, lie alongside any vessel during the discharge of her cargo, and if such permission is given no lights or fires shall be allowed on board such craft.

9. Every vessel having petroleum on board shall keep conspicuously exhibited from sunrise to sunset a red flag.

By order of the board of directors.

E. Latimer, *General Superintendent.*

Dock Office, *Manchester, July, 1897.*

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Messrs. The Manchester Ship Canal Co.,
Dock Office, Manchester.

Gentlemen: We hereby apply for permission to pump the oil from steamer ---------- lying in the Ship Canal opposite ---------- into the pipes leading into ---------- ---------- Storage Tanks and we agree to indemnify you against all losses, damages, costs, or expenses which you may incur or become liable for by reason of the granting of such permission.

We note your regulation regarding the leakage of oil into the canal or on to the quay and will take every precaution to prevent such leakage.

Yours truly,

MANCHESTER SHIP CANAL.

_____ hereby certify that the cargo of the _____ master _____, _____ register tonnage, consists of _____ tons of the product of petroleum, from _____ and that none of such product of petroleum gives off an inflammable vapor at a temperature of less than 73° of Fahrenheit's thermometer when tested in the manner prescribed by the acts of Parliament in force in that behalf.

Signature _____

Address _____

_____

Date _____

MANCHESTER SHIP CANAL.

DOCK OFFICE,

Manchester _____, *19* .

Rules to be observed in respect of tank steamer laden with common petroleum.

1. The accompanying notice sanctioning the use of fires and lights in certain parts of the vessel under the conditions mentioned therein is issued subject to there being no dangerous petroleum in the vicinity of the vessel.

2. During the discharge the tank lids must not be raised more than is absolutely necessary for the working of the pumps, and then only whilst the tank is being pumped.

3. All fires and lights must be put out on board and in the vicinity of the vessel whilst the tanks (after being emptied) are being ventilated, except in cases where the tanks are being steamed or otherwise cleansed under the supervision of an analyst.

4. Under no circumstances must any oil or water mingled with oil be pumped into the canal.

5. In the event of these rules not being strictly observed, the permission to use fires and lights during the discharge of the vessel will be withdrawn.

_____,

Harbor Master.

MANCHESTER SHIP CANAL.

DOCK OFFICE,

Manchester _____, *19* .

To the owner, master, or other officer or person in charge of the ship vessel called the _____ _____ whilst lying in the Manchester Ship Canal:

I, the undersigned, E. Latimer, harbor master of the port of Manchester, in exercise of the power for this purpose reserved to me by No. 3 of the regulations for the navigation of the ship canal by vessels carrying petroleum in bulk and for the discharge of petroleum in bulk in the ship canal, do by this notice under my hand authorize the use of the following fires or lights on board the above steamer.

DURING DISCHARGE ONLY.

(Before naked lights are used written notice must be given to the harbor master and arrangements made for the attendance of a police officer.)

(*a*) Fires and covered lights in the cabin, forecastle, galley, and engine and boiler rooms of the vessel subject to the provisions of the regulations.

(*b*) Naked lights in the engine and boiler rooms only for inspection or repairs subject to the provisions of the regulations for the use of fires and naked lights and to special supervision by a police officer at the expense of the owners of the vessel.

And I give notice that no fires or lights, other than those above mentioned, can be used on board such vessel.

AFTER DISCHARGE.

No fires or lights whatever shall be used on board the vessel except upon the production of a certificate from a properly recognized analyst that fires and lights may safely be used on board; but this condition shall not be deemed to apply if the tank lids are screwed down immediately the tanks are emptied, and the vessel leaves the canal on the tide following the completion of her discharge or coaling.

Attached to this notice is a copy of the rules made in respect of tank steamers carrying common petroleum, which must be strictly observed.

Dated this ------ day of ----------, 19 .

----------,
Harbor Master.

APPENDIX XXIV.

GENERAL REGULATIONS GOVERNING THE USE OF RIVERS AND CANALS IN THE NETHERLANDS.

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Appendix XXIV.

GENERAL REGULATIONS GOVERNING THE USE OF RIVERS AND CANALS IN THE NETHERLANDS.

General police regulations concerning rivers, canals, harbors, locks, bridges, and works belonging thereto, under Government superintendence established by royal order of the 13th of August, 1891 (Official Gazette No. 158), and revised by royal orders of the 17th of April, 1894 (Official Gazette No. 57), the 23d of April, 1897 (Official Gazette No. 105), the 8th of July, 1897 (Official Gazette No. 174), the 24th of June, 1905 (Official Gazette No. 217), the 6th of November, 1905 (Official Gazette No. 297), the 17th of December, 1906 (Official Gazette No. 329), the 23d of July, 1907 (Official Gazette No. 229), the 24th of December, 1908 (Official Gazette No. 421), and of the 25th of November, 1909 (Official Gazette No. 379).

Title I.—*General provisions.*

Article 1. These regulations apply:

(1) To the hereafter-mentioned rivers and Government canals, inclusive of their banks, harbors, natural and artificial works, plantations, buildings and whatever may belong thereto.

(2) To the hereafter-mentioned harbors, docks, bridges and works connected therewith.

In so far as those waters and works are under Government superintendence and in so far as these regulations are not contrary to special regulations.

The rivers referred to under (1) are:

The Ijssel with its outlets into the Zuyder Zee; the Nieuwe Merwede, the Wantij, the Mallegat, the Dordtsche Kil, the Krabbe, the Maas, inclusive of the separate part thereof between the Weleind and the Waal near to Woudrichem; the Bergsche Maas, the Heusdensch Canal, the Oude Maasje, the Donge from the point on the left bank at which it separates from the Gravemoersche Channel to its outlet into the Amer; the Amer, the Killen (creeks) in the Bergsche Veld, the Hollandsch Diep, the Koningshaven, the Oude Maas, the Nieuwe Maas within the commune of Rotterdam, the rivers below Rotterdam to the sea, the Spui inclusive of the Beerengat, the Hartelsche Gat, the Hollandsche Ijssel inclusive of the Sliksloot, the Zwarte Water and the Zwolsche Diep.

The dispersed works referred to under (2) are:

(*a*) The harbors of Moerdijk, Breskens, Veere, and Delfzijl, the outer harbor at Scheveningen, the outer harbor at Middelharnis, in so far as it is under Government superintendence, and the harbors of the islands Terschelling, Vlieland, Wieringen, Urk, and Marken.

(*b*) The Government locks and movable bridges in the Province of Friesland.

(*c*) The Government locks and bridges in the waterway from Amsterdam to Rotterdam.

(*d*) The locks at St. Andries and in the closed creeks (killen) of the Bergsche Vela, with their harbors.

(*e*) The swing bridge at Raamsdonk, and the rolling bridge at Geertruidenberg, both across the river Donge, the opening bridge across the Oude Maas at Cappelle and the rolling bridge at Besoyen.

(*f*) The movable bridges across the river "de Mark" and "Dintel" at Standdaarbuiten and near Dinteloord.

Art. 2. In these regulations, as in the special regulations, are designated by: Sailing vessel, all vessels under sail and not under steam; steamers, all vessels under steam no matter whether

carrying sail or not; captains, those who are in command of ships or timber floats, or whoever act in their stead; day, the time between sunrise and sunset; night, the time between sunset and sunrise; minister, the minister intrusted with the execution hereof; our commissary, the Queen's commissary for the Province in which the river, the canal, the part of the river, the canal or the works referred to are situated; chief engineer and engineer, the chief engineer, director and engineer, charged with the superintendence of the river, the canal, the part of the river, the canal or the works referred to; waterstaat officers, the chief engineers, directors, engineer, assistant engineers, surveyors and assistant surveyors of waterstaat (the Department of Public Works), and the Government beacon masters; canal officers, the harbor masters, head and assistant lockmasters, head and assistant lockmen, stowing men, bridgemen, ferrymen, canal men and dyke men, lock, bridge, and harbor hands in Government service.

ART. 3. These regulations shall be printed in the Dutch, English, German, French, and Norwegian languages and, like the special regulations, shall be procurable generally.

Any captain navigating any of the waterways named in article 1, or making use of the therein designated works, must be provided with a copy of these regulations, and of the special regulations, as well as the provisions for preventing collisions on public waterways within the Kingdom. He is bound to produce them, if required, to the officers and officials mentioned in article 88.

TITLE II.—*Provisions respecting the use of rivers, canals, and harbors.*

ART. 4. All ships of more than 1 meter draft must be provided at their sterns with a scale on which the draft may be easily read.

Neither the screw nor any other part of a steamer may project below the keel, unless the scale of draft is counted from the underside of that part.

ART. 5. Vessels with no fixed deck and of a larger tonnage than 10 tons, must be provided with water-tight planks, boards or sides reaching at least 0.25 meter, above the surface of the water.

ART. 6. The name of the vessel and in the case of nonseagoing vessels, the name and residence must be clearly indicated in a conspicuous place on the outside of the vessel.

This provision only applies to vessels of more than 10 tons tonnage.

ART. 7. Without leave or express orders of a waterstaat officer or canal officer no vessels are allowed to take up berths in any canal or harbor other than those appointed for that purpose or when abreast to navigate any canal or harbor.

Ships are also forbidden to lie or be adrift athwart the fairway.

ART. 8. Any sea ship in any Governmental water or its harbors is to keep the colors of the nation to which she belongs, hoisted from sunrise to sunset. Ice-bound ships are excepted.

Ships whose draft exceeds 4 meters have to hoist a small foremast flag besides. Ships of less draft are forbidden to do so.

No merchant ship is allowed to hoist a pennant on any account whatever.

ART. 9. Any captain leaving his ship shall appoint a capable person as his substitute. This provision does not apply to ships of less than 10 tons tonnage, or those propelled from the shore by means of poles.

No ship of 10 tons and more tonnage may lie without any hands aboard on a Government water without leave of the harbormaster or a waterstaat officer.

Nor may a ship having no one on board in charge be allowed to drift on any Government water.

ART. 10. The captain of a ship overloaded, or in the opinion of the harbormaster or any waterstaat officer insufficiently manned or rigged, shall on the intimation of the said officers stop her course and cause her to be removed according to the directions of the said officers.

The captain of a vessel in a foundering state shall, as soon as possible, remove her out of the fairway.

ART. 11. The captains of nonseagoing ships shall have their jib booms topped before reaching the locks.

When ships are discharging their cargoes entirely or partly, the harbormaster, the lockmaster, or the waterstaat officers may direct their topgallant yards and topgallant mast to be taken down.

ART. 12. It is forbidden to place a ship in such a way as to obstruct the passage into or out of a harbor or through a lock or a bridge.

The captain of such a ship shall remove her immediately on the intimation of a waterstaat officer or a canal officer.

ART. 13. No ship shall enter a harbor or port when during the day a red flag is hoisted or during the night a red light is placed on one of the piers of the same, as a sign of the entrance being obstructed by ships or other causes.

ART. 14. The opening of a lock to let the water through is announced at least one hour before during the day by a blue flag, bearing the word "spuien" in white letters, and during the night by three red lights placed in the angles of an equilateral triangle with the top upwards.

This signal being displayed, or the opening of the lock for letting the water through having been given notice of by one of the canal officers, captains whose ships are in a canal or harbor shall see that they are firmly moored and, if necessary, anchored, to prevent their running aground.

In this case the canal officers are qualified to assign berths to the captains of the ships and to direct them as to the manner of mooring their ships.

No fit berths being available, laden ships are to be accommodated first.

ART. 15. On approaching a lock or a bridge, captains shall slacken the speed of their ships in such a way that in case of need they may be stopped at 100 meters distance from the lock or bridge. At the signs of posts fixed for that purpose the sails shall be lowered or clewed. The lock or bridge men must be warned either by means of the steam whistle, ship bell, or foghorn, or by shouting.

The captain shall stop his vessel if, by day, the red cylinder is covered by a half ball or a red board or a red flag; and if, by night, a red light is displayed on the lock or bridge.

The lockmasters and bridgemen, if necessary, according to the judgment of the minister, shall indicate the exact place of passing the bridge or lock during the night by green lights.

ART. 16. When two or more ships at the same time approach lock or bridge, the lock or bridge man regulates the order of approaching, and the distance to be kept between them.

ART. 17. Each ship is to pass the lock in turn according to the order of arrival, saving the stipulations in the next article.

Any ship whose crew are found guilty of cutting the towlines or ropes of another's ship shall pass the lock only after the ship whose towlines or ropes have been cut.

When ships wanting to be let through approach the sluice from opposite directions, they pass by turns from either side, beginning with the ship approaching from that side where the water is on a level with that within the lock. When there are many ships wanting to be let through, the lockmen, for the sake of order, are authorized to distribute tickets, indicating the turn of each ship to be let through the lock.

ART. 18. The right to be let through the lock first is granted in the following order to ships hoisting a pennant; Government ships and ships serving for the conveyance of waterstaat officers and canal officers on duty; ships serving for the regular conveyance of persons; ships loaded with fresh fish; ships serving for the regular conveyance of goods or cattle, with their lighters and barges. Vessels loaded with gunpowder, fireworks, guncotton, nitroglycerine, or other explosive or easily inflammable substances are to pass, if possible, before all other ships, no other ship being allowed to come within the lock at the same time.

ART. 19. Every ship within the lock, or in its proximity, must be duly moored fore and aft, at the place indicated by the canal officers.

Ships that are to pass or be let through shall not approach the bridge or lock until the canal officer gives the sign thereto.

If, in the opinion of the canal officers, the ship whose turn it is does not approach promptly enough he is qualified to make another ship pass first.

When a ship in passing a lock or a bridge is not made to do so with sufficient speed, in the judgment of the canal officer, he is qualified to take the necessary steps.

ART. 20. On ships passing a lock all sails should be lowered and fastened; on those passing a bridge all sails should be clewed.

The hauling, the winding in and out, and the mooring of ships may only be performed by means of the contrivances placed there for that purpose.

In passing the locks or bridges the ships are not allowed more speed than is needed to steer them.

No ropes or chains are allowed to be dragged along when passing the locks and bridges, crossing telegraph cables and ferries, and passing working dredging machines.

It is, saving the stipulations in the second clause, forbidden to stick hooks or poles into the works, or to fasten to them any vessel or timber float without leave of the lockmaster or bridgeman.

ART. 21. In case the passage through a lock or a bridge is inexpedient on account of stormy weather or on account of the water being let through the locks, drawn off from the canal, or let into it, the lockman or bridgeman may refuse it.

It is forbidden to pass a lock or a movable bridge that must be opened for the passing of ships during the absence of the concerned canal officer or in opposition to his orders.

ART. 22. Every time two ships consecutively have passed a bridge, the bridge, if necessary, shall be closed in behalf of the foot and vehicular traffic.

Several ships tugged by the same steamer may pass together.

In passing a bridge ships going downstream have the preference above those going upstream.

When there is no stream, vessels going before the wind have the preference above those that are tugged or towed by horses.

ART. 23. Should any ship in a canal or a harbor become icebound, the captain is bound to cause a space of at least half a meter in width to be made in the ice around the ship and have this kept open.

The navigation on a canal, when the waters are frozen up, may be prohibited by our commissary.

ART. 24. Frosty weather setting in or contrary winds blowing steadily, any ship lying in the outer harbor shall, on the intimation of the harbor master, either be hauled out to the roadstead or passed through the lock into the inner port.

In this case, and also when, the water being frozen over in the canal, vessels are let through the locks into the inner basin, any vessel in the canal shall, if necessary, tow farther up according to the directions of the canal officers.

ART. 25. In transporting, taking in, and discharging easily inflammable or explosive goods or quicklime, captains, besides being subject to the laws and prescriptions on this head, shall observe the special precautionary measures prescribed to him by the waterstaat officers and canal officers.

ART. 26. If a ship has lost any object which, floating or sunk, might be dangerous or obstructive to the navigation, the captain is bound immediately to give notice thereof to the waterstaat officer or to the canal officers to whose district the fairway belongs.

The place where such a sunken object is lying shall immediately be marked by the captain by means of a buoy.

The captains shall take care that no lighters, floats, or beams used by their vessels shall be found loose or unmoored.

ART. 27. In case any ship runs aground and her cargo has to be discharged in order to get her afloat, in the opinion of the waterstaat officers or canal officers, her captain shall do the same without delay.

ART. 28. The captain of any ship that has sunk or run aground shall immediately inform the nearest canal officer of the accident.

ART. 29. As long as the authorities have not proceeded with the removal of the ship, in virtue of the law of July 23, 1885 (Gazette, No. 151), the parties concerned may have the sunken ship raised or float the ship run aground.

ART. 30. On passing deep-laden vessels, dredging machines, vessels that are taking in or discharging, timber floats, or other floating contrivances, for which the swell might be dangerous, notice of which is given by displaying a red flag by day and two bright-burning red lights at night, perpendicularly hoisted one above the other with a space between them of no less than 0.5 meter and no more than 1 meter, steamers shall slacken their speed to such a rate as is necessary to prevent a dangerous swell.

They shall do the same in those parts of rivers or canals where by order of the qualified waterstaat officers or the boards of inspection of the dikes (dijkbesturen), the above-mentioned signals indicate that any danger or damage might be caused by the swell.

ART. 31. Steamships carrying high-pressure engines must let out their exhausted steam by an escape pipe outside the funnel, unless the funnel be covered with a partition of wire netting of meshes not exceeding 5 millimeters in width. Such partition must be found in all steamers whose boilers are heated by means of coke, peat, or wood.

ART. 32. Timber floats must be fastened and joined at both ends in such a way that they can not obstruct the navigation nor cause damage to other ships and timber floats or the works. The beams are not to be fastened crosswise, but in such a way that they may easily be counted.

The laths for fastening the beams may not project beyond the float.

Any timber float shall be provided with a white board placed along the ship, on both sides of which board the name and residence of the captain or the owner are to be read, painted in black letters of no less than 30 centimeters' height and 5 centimeters' width.

ART. 33. No ship shall discharge her cargo of timber into the water in order to convert the same into floats unless the officer whom it concerns has given leave thereto.

In no case is it allowed to discharge more beams at a time from any ship than can be formed immediately into one or more floats, a sufficient number of hands being on the spot.

These stipulations also apply when beams to be formed into floats are launched from the shore into the water.

ART. 34. Captains with their timber floats shall not leave their berths earlier than one hour before sunrise. They are not allowed to continue their voyage later than one hour after sunset, unless peculiar circumstances may prevent them from reaching the landing place before that time.

In the case of fog, snowdrift, storm, drift ice, and the ice breaking up, timber floats are not allowed to be transported.

If they are overtaken by them on their way they must be brought to anchor or moored at the first available landing place.

No timber float may stay in a harbor without the harbor master's leave thereto.

ART. 35. Timber floats are only allowed to pass locks and bridges after the ships present, unless they, fastened to a ship, can be let through together with the ship.

ART. 36. No timber float shall approach a preceding float within a distance of 500 meters.

ART. 37. The articles 7, 9, 10, 12, 14–17, 19, 22–26, 28, and 29 of these regulations apply to timber floats as well as to vessels.

ART. 38. Saving the stipulations laid down in the special regulations, anyone is permitted to tow with horses.

ART. 39. The drivers must, as far as possible, be careful to keep the lines tight while towing across any ship or timber float and to slip the same in due time when not crossing above it.

They are bound to slip the line at the fixed signs, to slacken their speed on approaching any lock or bridge, and in everything to comply with the injunctions of the waterstaat officers or canal officers.

They shall warn the captain of everything calculated to obstruct the navigation.

The captains of vessels moored at a towpath shall, as far as possible, lower their masts and assist the passing ships and timber floats in carrying over their towlines.

ART. 40. Any driver, punished for the infringement of any of the stipulations of these regulations, or being found drunk, may be refused the right of towing by the waterstaat officers or the canal officers.

ART. 41. Any captain of a ship being towed is bound to comply with the orders of the captain of the steam tug in respect to the towing of his ship.

In case of his refusing or neglecting to veer or haul in the ropes, the captain of the steam tug has the right to drop the ropes.

ART. 42. The towropes of ships being towed are to be dropped by their captains only by turns, and in such a way that the hindmost ship drops first and the foremost ship last.

In each case the captain of the steam tug shall give the sign for dropping the ropes by striking the bell.

ART. 43. Anyone doing duty as a pilot on board a ship navigating a river, a canal, or in a harbor shall, with respect to the police ordinances for the said waters, comply with the directions of the waterstaat officers or the canal officers.

ART. 44. Anyone doing duty as a pilot on board a ship is bound to have with him a printed copy of these regulations, of the special regulations for the water on which he is navigating, and of the "Regulations for preventing collisions."

ART. 45. Any person doing duty as a pilot, being found drunk, may be removed from office by the waterstaat officers or the canal officers.

ART. 46. In the case of any ship having caused damage to any of the works, or any infringement having been made of these regulations or of the special regulations for the water on which she is navigating, the pilot shall as speedily as possible give notice thereof to the harbor master or the nearest waterstaat officer or canal officer.

ART. 47. Except with the permission of the waterstaat officer, no captains, unless in case of necessity, shall cast anchor or moor or lie at anchor or moorage (1) in places where navigation would be obstructed; (2) during salmon fishing in any part of the river at 190 meters above the place where the drag nets of the salmon fishery are attached by means of a fixed winch, and 100 meters below the lowest point for drawing in such nets.

The prohibition mentioned under (2) is only of effect in the parts of the river and during the period in which salmon fishing is actually carried on.

ART. 48. The captains of ships and timber floats, staying in a canal or a harbor shall be bound to haul them out to the berths, assigned to them by the waterstaat officers or canal officers, which berths, if necessary, may be shifted according to their directions.

ART. 49. No ships are allowed to lie nearer to the locks or the bridges than the signposts for stopping indicate, unless with leave of a waterstaat officer or a canal officer.

ART. 50. Except in case of accident and the cases in which it is prescribed, no bells may be tolled on board any ship or timber float during the night.

ART. 51. Any captain on board of whose ship a fire bursts out, shall immediately cause the bell to be tolled, or a similar sound to be made, and the ship to be hauled out of the neighborhood of other ships.

ART. 52. On board any ship or timber float in a canal or a harbor no easily flaming or, when inflamed, foul burning articles may be melted, cooked, or warmed without leave of a waterstaat officer or a canal officer.

It is also forbidden, unless it be prescribed or allowed by the competent authority for a special purpose, to fire off cannon, guns, or pistols, explode gunpowder, or let off fireworks on board any ship or timber float.

ART. 53. Captains wishing to leave a harbor with their ships shall give notice thereof to the harbor master, who, if necessary, shall decide the order in which the ships and timber floats are to haul out.

ART. 54. It is forbidden without leave of the minister (1) to settle with a ship or timber float in any river, canal, or harbor for the purpose of carrying on a trade, keeping inns or lodging places or fixed domicile; (2) to break up ships in any canal or harbor.

The engineer, charged with the execution of a work, may allow a lodging place to be kept aboard a vessel for the accommodation of such persons as are employed at the said work.

TITLE III.—*Special provisions relative to the use of rivers.*

ART. 55. It is forbidden to navigate any part of a river with a ship of more draft than the lowest depth of the channel of the river allows, as indicated at low water.

Captains of ships navigating parts of rivers marked out for navigation by buoys, beacons, and other signs—namely, parts whose little depth or breadth or even temporary shallowing may call for special care in the navigation thereof—shall comply with the directions and orders of the waterstaat officers and canal officers with respect to the navigation in these parts.

Captains shall observe the orders of the authorities, waterstaat officers, or the canal officers made known by public announcement or by fixed warnings on posts, where (*a*) in the parts of the river referred to in the second clause of the article, navigation at night is forbidden; (*b*) in the parts of the river where, after obtaining the permission of the proper civil authorities, military practice is taking place, and navigation is temporarily determined or forbidden.

Such a prohibition will in due time be publicly announced to all concerned in the navigation of ships and timber floats.

It is forbidden to act contrary to such a prohibition.

ART. 56. When a steamer, going up stream without towing any ship, has approached the last of a convoy of ships towed below a narrow passage within a distance of 120 meters, this convoy may not enter the narrow passage until they have been passed by the former steamer.

ART. 56bis. On every ship there shall always be a capable steersman of at least 17 years of age at the wheel during navigation.

To ships without motor power of less than 150 tons tonnage this provision does not apply.

ART. 57. Timber floats must have at least a crew of two hands for each 75 cubic meters of hardwood and two hands for each 150 cubic meters of softwood.

As hardwoods are considered, among others, oak, beech, elm, ash, cherry, pear, apple, and dogwood; as soft woods, among others, poplar, alder, fir, pine, and larch wood, and other resinous woods.

ART. 58. For timber floats towed by steamers, half the number of the obligatory crew named in article 57 is sufficient, provided the timber float at the foreside be furnished with a suitable arrangement for steering and the steam tug have the following power: (1) With timber floats, of which the obligatory crew number no more than 50 hands, at least 25 actual horsepower; (2) with timber floats, of which the obligatory crew number more than 50 hands till 80 included, at least 35 actual horsepower; (3) with timber floats, of which the obligatory crew number more than 80 hands, at least 45 actual horsepower.

ART. 59. No timber float is allowed to have a crew of less than three hands, the captain of the float included.

ART. 60. Floats, of which the obligatory crew number more than four hands, must be provided with the following implements:

For floats of which the obligatory crew number—	Large anchor boats.	Small anchor boats.	Large cables.	Small cables.	Anchors.	Chains.
5 to 9 men	.....	1	.....	2	2	.....
10 to 13 men	.....	1	1	1	3	.....
14 to 25 men	.....	2	1	1	4	.....
26 to 35 men	2	1	2	2	6	1
36 to 40 men	3	1	2	3	7	1
41 to 45 men	3	1	3	3	8	1
46 to 50 men	3	2	3	3	9	1
51 to 60 men	4	2	3	3	10	2
61 to 70 men	4	2	4	3	11	2
71 to 80 men	4	2	4	4	12	3
81 to 90 men	5	2	5	4	13	3
91 to 100 men	5	2	5	4	14	3
101 to 110 men	6	2	6	5	16	4
111 to 120 men	6	2	6	5	18	4
121 to 130 men	7	2	7	5	20	4
131 to 140 men	7	2	7	5	22	5
141 to 150 men	7	2	8	5	24	5
151 to 160 men	8	2	8	5	26	5
161 to 170 men	8	2	8	5	28	7
171 to 180 men	8	2	8	5	30	7
181 to 190 men	9	3	9	6	32	8

OBSERVATIONS.

1. Large anchor boats are those that can carry a freight of more than 1,750 kilograms; small anchor boats, those that can carry a freight of 1.750 kilograms or less.

2. Timber floats of which the obligatory crew number no more than seven hands, may have, instead of the small anchor boat, a little boat, so called "Dreibord," of 8 meters length and of from 1 to 1.4 meters breadth at the upper side.

The boat of the warner (waarschuwer) is not included in the above-mentioned number of boats.

ART. 61. The passage openings of the floating bridges shall be indicated according to the following stipulations:

(1) As soon as the separate parts of the bridge have swung out and a passage can be made, each of both sides of the opening must be indicated during the day by a red-white flag, during the night by two red lanterns, placed above each other.

The lanterns may throw their light only toward that side where the ship is that is first allowed to pass.

(2) If a bridge on account of some obstacle, storm, damage, etc., temporarily can not be opened, this circumstance is to be made known to the ships wanting to pass, during the day by a blue-white flag, during the night by two green lanterns, placed above each other.

(3) The following warning signals must be given to inform approaching vessels at a greater distance that they can pass the bridge: (*a*) As a sign that the bridge may be passed down stream, during the day a red flag, during the night a red lantern; (*b*) as a sign that the bridge may be passed up stream, during the day a white flag, during the night two red lanterns.

(4) The lanterns must burn sufficiently bright, and the flags, in order that they might stream the better, be only so large that they are easily to be distinguished at the required distance.

The breadth of the flags must be at least equal to their height, but may exceed the latter only by one-half of it.

The flags must be hung to slanting or horizontal staffs or ropes, or partly stretched upon a frame.

Two-colored flags must be divided horizontally; the lower part must be white, the upper part red, or when using blue-white flags, blue.

If through fog or other causes, the above-mentioned signals can not be clearly distinguished or are not visible, ships may not pass before having obtained leave from the bridgemaster in another way.

ART. 62. Fishing tackle shall not be fastened or remain fastened to or in the bottom or to the bank with anchor or any other articles: (1) in the fairway, except with the permission of the minister; (2) outside the fairway, unless its site during the day is indicated by clearly visible buoys; during the night by a bright white light, and placed perpendicularly above it, at a distance of at least 0.50 meters and at the most 1 meter, a red light, both of which must be clearly visible from all sides.

This prohibition does not apply to fixed fishing tackle (ankerkuilen) fastened to a boat. In the use thereof the boat must be so placed however that together with its fishing tackle it does not interfere with the navigation.

TITLE IV.—*Special provisions for the use of canals and harbors.*

ART. 63. The special regulations fix for each canal the maximum of the allowed dimensions of the ships.

In the case of temporary shallows or low water the waterstaat officers or the canal officers may limit the draft allowed by the special regulations.

No ship of larger dimensions than those allowed by the first and second clause of this article is permitted to navigate a canal, except by a written permit of the chief engineer.

ART. 63bis. On every ship of more than 10 and not exceeding 150 tons tonnage there shall always during navigation be one person of at least 17 years old on deck, while on every ship of 150 and more tons tonnage there shall always during navigation be a competent steersman, of at least 17 years of age, at the wheel.

This provision does not apply to ships propelled by a pole from the shore.

Deviation from the provision of the first clause is allowed in regard to open boats (bakken), lighters (zolderschuiten), or similar vessels not exceeding 75 tons tonnage, which are attached in such a way that they form one whole, provided only the written permit of the harbor master has been given and with due observance of his stipulations.

In the issue of such written permit and the stipulations therein laid down, there shall be no deviation from what the special regulations for any canal may eventually prescribe in deviation from article 7 of these regulations.

ART. 64. Except in outer ports, opening on rivers, floods, roads, sea harbors, or other fairways, where anchoring is allowed, no anchors may hang overboard, unless leave is granted to the captain by the lockmaster or the harbormaster.

On the cleats along the wales or the fore ends of the leeboards no protruding iron spikes or points may be fixed.

ART. 65. In passing a canal no square or studding sails may be set.

On square-rigged ships, whether navigating or moored in a canal or a harbor, the captains must cause the yards as far as possible to be braced on larboard along the ship.

On ships going out, the yards must be topped on larboard; on ships going in on starboard. The jibboom and the flying jibboom must be hauled in or taken in if necessary.

ART. 66. It is forbidden, wherever canal banks serve as a high road, to have the main boom, bowsprit, or other rigging projecting over the canal boards, and either to lower the sails or make them fall over at that side of the canal.

ART. 67. The special regulations fix the maximum of speed at which steamers are allowed to proceed.

In behalf of the navigation or the works the waterstaat officers or canal officers may limit the rate of this speed for a time.

Without a written permit of the chief engineer no ship shall proceed at a greater rate of speed than allowed in the first and second clause of this article.

ART. 68. Steamers are not allowed to proceed at a rate exceeding 75 meters in a minute: (1) When navigating between the fixed post or signs near the locks, bridges, and ferryboats; (2) on passing steamers navigating in a contrary direction.

In case of need the canal officers are qualified to order the captains to slacken even the speed designated above.

ART. 69. The special regulations will specify for each canal the dimensions allowed to timber floats and the rate of speed at which they may be towed.

It is forbidden to navigate the canal with timber floats of larger dimensions, or to tow timber floats at a greater rate of speed than the preceding clause allows, unless with a written permit of the chief engineer.

ART. 70. On the completion of a timber float it must immediately leave the canal, or, if the place of its destination is situated on the canal, be towed to that place, where within 48 hours it must be taken to pieces and cleared out of the canal. Except in the case of the insurmountable, timber floats are allowed to stay only at such places as are indicated by the special regulations, and those assigned to them by the canal officers.

ART. 71. A timber float of no more than 25 beams may be fastened to a ship, provided one man is on it to steer it.

Any other timber float shall be towed separately.

When not fastened to a ship any timber float of 25 meters long and less shall have at least two able-bodied men on it for the purpose of steering it.

For each 20 meters more of length, or part thereof, one man more shall be present for the purpose of steering it.

Timber floats fastened to one another are considered to be one float.

ART. 72. The masts or towing poles on timber floats may not be higher than 4 meters above the water.

ART. 73. It is forbidden to put more than two horses abreast to the towlines.

ART. 74. The largest number of ships to be towed by a steam tug is fixed by special regulations.

It is forbidden to tug a larger number of ships than is stipulated in virtue of the first clause of this article.

ART. 75. No ships being towed in a canal are allowed to carry any sail. During their navigation all their sails must be lowered or taken in.

ART. 76. Ships and timber floats staying at any place must be moored, if possible, to the mooring poles, or posts placed for that purpose.

On any ship approaching, if needed, all chains and ropes must be slipped in time and to such an extent that the passage be free.

ART. 77. In no canal or harbor may anchors be brought out from any ship unless in the case of heavy currents, when the water is being let through the locks, and in necessary cases.

The captains of nonseagoing ships, however, if no mooring poles or posts are found, may use kedge anchors wholly stuck in the ground and near the canal board.

ART. 78. Ships shall take in or discharge cargo only at the spots designed for that purpose or assigned by the canal officers.

It is forbidden to deposit or discharge any object on the banks of the canal without leave of a waterstaat officer or a canal officer.

ART. 79. In loading or discharging any ship no obstruction of the roads or berms may take place.

The captains of ships lying close to each other are obliged, for their common convenience, to allow the necessary space, for the use of lighters and for hauling out.

ART. 80. The captain of a ship lying at a landing place must allow another ship to lie alongside his ship and to communicate across her with the shore, provided this be not for the purpose of taking in or discharging cargo.

ART. 81. Any ship having completed or discharged her cargo shall immediately make room for any other ship wanting to take in or discharge her cargo at the same place.

In case of want of room, several ships arriving at the same time, those coming to take in their cargoes have the preference over those coming to discharge.

ART. 82. The chief engineer, and in case of need the engineer, is qualified to raise or to lower the level of the canal.

TITLE V.—*Provisions for the conservation of the canals and whatever belongs thereto.*

ART. 83. Except in cases of acquired rights, it is forbidden, without leave of the minister (1) to draw off water from any canal or water course belonging to it; and (2) to effect any works in, on, under, or across a canal, its harbors, bermditches, berms, dikes, towpaths, roads, or other grounds belonging to the canal.

In deviation herefrom our commissary, however, may sanction the alteration or removal of any stairs, steps, footpath, horse path, railings, or outlet along the canal dike or road, the necessary works in the bermditch included.

ART. 84. It is forbidden (1) to obstruct or prevent the use of the works; (2) to throw or drop into a canal or on the grounds belonging to it solid matter unless with a written permit of the chief engineer; (3) to walk or drive across any bridge before it is duly closed and fastened, or to cross the lock doors before they are quite closed; (4) to drive over a bridge otherwise than at a walking pace; (5) to open the barrier before a bridge without leave of the bridgeman; (6) to carry across a bridge a load of which the weight, in the opinion of the bridgeman, might damage the bridge; (7) to enter the ferryboats or take anything into them contrary to the prohibition of the ferryman; (8) to enter any work to which the access is prohibited in a way conspicuous to every one; (9) unless at the positive request of the canal officers, to tilt, turn, open, or close a bridge; to open or shut lock doors, to draw or shut bolts, to raise the flood gates; or perform other duties of the canal officers; (10) to deposit on any of the places of embarkation or discharge any goods not destined to be shipped or discharged, or to let goods lie beyond the time fixed by the canal officers for embarking or removing the same.

ART. 85. Except in cases of contract rights, it is forbidden, without leave of the minister, to drive or ride on any grounds not public roads belonging to a canal.

This prohibition does not apply to the vehicles of the waterstaat officers or canal officers and to tow horses, as far as relates to towpaths.

ART. 86. Unless permission has been granted by contract provisions, it is forbidden, without leave of our commissary, to graze horses or cattle on any of the canal grounds.

Unattended cattle found on any of the canal grounds may be removed by the canal officers.

TITLE VI.—*Provisions respecting dispersed Government works.*

ART. 87. Respecting the passage and further use of the works mentioned in article 1, third clause, under (*b*), (*c*), (*d*), (*e*), and(*f*), the provisions mentioned under Titles II, III, and IV of these regulations respecting the use of locks, bridges, and further works shall apply.

To the works named in the first clause, and also to the harbors mentioned in article 1, third clause under (*a*) the provisions mentioned under Title V, in regard to the maintenance of the locks, bridges, and other works belonging to the canals shall apply.

TITLE VII.—*Provisions relating to the enforcement of these regulations and the special regulations and penalties.*

ART. 88. The enforcement of these general regulations and the special regulations is intrusted to the governmental and local police, the waterstaat officers, the officers of the pilotage, of the revenue cruisers (ambulante recherche te water) the superintendence of fisheries, and the canal officers.

The officers and officials designated in the first clause are qualified to the actions detailed in article 6 of the law of February 28, 1891 (Gazette No. 69).

The reports drawn up by them are forwarded to the legal officer charged with prosecution thereof at the district court (kantongerecht), and copies are sent to the chief engineer.

ART. 89. The waterstaat officers and the harbor masters are qualified to the actions detailed in article 3 of the law of February 28, 1891 (Gazette No. 69).

ART. 90. The captains are bound to comply with all injunctions given them by the waterstaat officers and the canal officers in behalf of the navigation or of the works.

They may appeal from the injunctions of the officers named in the first clause to our commissary, immediate submission, however, to those injunctions being obligatory.

ART. 91. Of all damage caused to the works referred to in these regulations and the special regulations, a report is to be drawn up by the waterstaat officer or the canal officer who discovers or is informed thereof.

This report shall state the condition of the damaged part before the accident; the circumstances attending it; the probable costs of repairing the damage; the person held responsible for the payment, and the sum he is bound to refund.

In fixing this sum the state of the works before the damage caused shall be taken into account.

This report shall be forwarded to the chief engineer by intermediary of the engineer, and, if possible, a copy of it shall be served on the captain concerned.

In pursuance of article 4 of the law of February, 1891 (Gazette No. 69), appeal may be made to the chief engineer.

ART. 92. Infringements of these general regulations, in so far as they are not provided against by the law, are punished as follows:

(*a*) By imprisonment for a period not exceeding 60 days or a fine not exceeding 300 guilders, in case of the infringement of articles 10, first clause, 12, 13, 55 second and third clause, 67 third clause, and 68 first clause, if the infringement is made with respect to a river, canal, or harbor, destined to be navigated by sea ships.

(*b*) By imprisonment for a period not exceeding 30 days or a fine not exceeding 150 guilders in case of (1) the infringement of the stipulations named under (*a*), if it is made with respect to any water not destined to be navigated by sea ships; (2) the infringement of articles 15 second clause, 25, 27, 48, 51, and 83 (1).

(*c*) By a fine not exceeding 100 guilders, in case of the infringement of articles 7, 8, 10 second clause, 14 second clause, 15 third clause, 19 first clause, 21 second clause, 24, 30, 34 second clause, 42, 43, 47 (1) and (2), 54, 55 first clause, 56, 56 bis. 61, 62, 63 third clause, 63 bis., 69 second clause, 77, 83 (2), 84 (1), and 90 first clause.

(*d*) By a fine not exceeding 75 guilders, in case of the infringement of articles 28, 31, 32, 34 first clause, 46, 49, 57, 58, 59, 60, 66, 70, 71, 81, and 84 (5).

(*e*) By a fine of not exceeding 50 guilders, in case of the infringement of articles 4, 5, 6, 9, 15 first clause, 19 second clause, 20, 26, 39 second and fourth clause, 52 first clause, 64, 65, 76, 79, 80, and 84 (2) and (9).

(*f*) By a fine not exceeding 25 guilders, in case of the infringement of article 3 second clause, 11 first clause, 23 first clause, 33, 34 third clause, 36, 39 first and third clause, 44, 50, 52 second clause, 53, 72, 73, 75, 78, 84 (3), (4), (6), (7), (8), and (10), 85 and 86.

Infringements of articles 7, 9, 10, 12, 13, 14 second clause, 15, 19 first and second clause, 20, 21 second clause, 23 first clause, 24, 25, and 26 by timber floats are punished with the penalties fixed hereabove for the infringement of those stipulations.

The infringement of the prohibition, issued in virtue of article 23 second clause, is punished by a fine not exceeding 75 guilders.

FINAL STIPULATIONS.

ART. 93. The minister is qualified to allow or to order a deviation from the stipulations of the articles 4, 5, 6, 8, 18, 31, 32 third clause, 47, 58, 59, 61, 73, 75, 79, and 84 of these regulations.

ART. 94. To ships already navigating at the time these regulations enter into operation, a term of two years is granted for complying with the prescription of article 4 first clause.

APPENDIX XXV.

SPECIAL REGULATIONS RELATING TO THE NORTH SEA (AMSTERDAM) CANAL.

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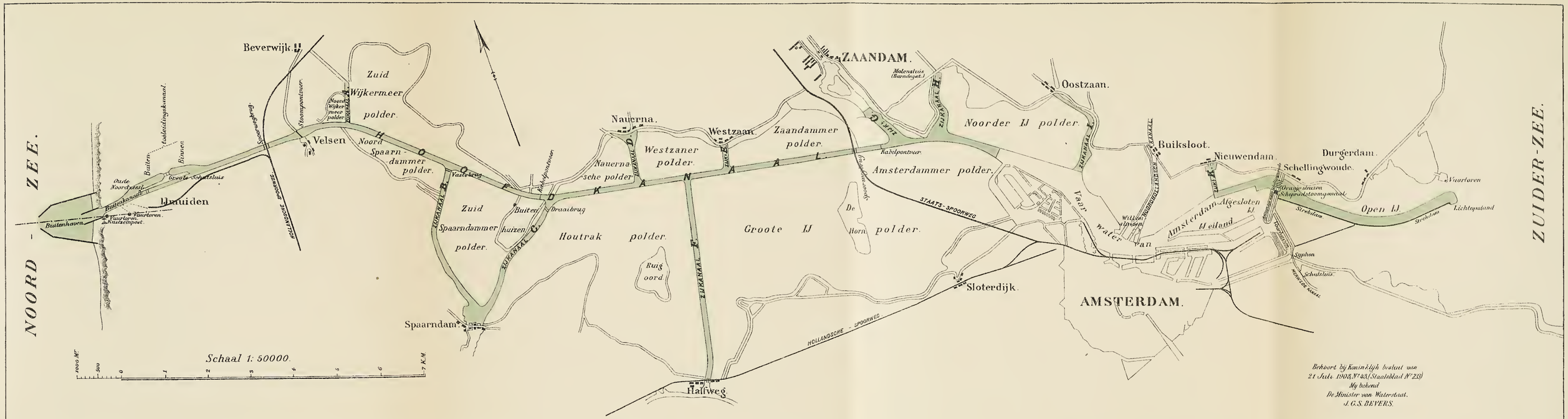

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Appendix XXV.

SPECIAL REGULATIONS RELATING TO THE NORTH SEA (AMSTERDAM) CANAL.

Special police regulations relating to the North Sea Canal (Noord-Zeekanaal), determined by Royal order of July 21, 1908 (Official Gazette No. 233) and of the 25th of November, 1909, (Official Gazette, No. 373).

Article 1. These regulations apply to:

(*a*) The outer port on the North Sea. [See map of North Sea Canal.[1]]

(*b*) The outer canal with the outer canals leading to the North Sea Locks.

(*c*) The North Sea Locks, viz, the new or large lock and the old North Sea Locks, consisting of the middle lock, the small lock, and the discharging sluice.

(*d*) The inner canal leading to the North Sea Locks and the main canal to the boundary of the waterway under the control of the community of Amsterdam, which boundary is indicated by two posts on the southern bank.

(*e*) The side canals—to Beverwijk (side canal A), to a distance of 890 meters from the center of the main canal; to Spaarndam (side canals B and C); to Nauerna (side canal D); to Westzaan (side canal E); to Halfweg (side canal F); to Zaandam (side canal G); to a distance of 1,000 meters measured from the axis of the main canal; to the Molen sluice (Barndegat) (side canal H); to Oostzaan (side canal I); to Nieuwendam (side canal K).

(*f*) A strip of water in the shut-off IJ, 100 meters wide, adjoining the grounds between the mouth of the side canal to Nieuwendam (side canal K) and the Oranje Locks, with the fairway within those locks to a distance of 500 meters measured along the axis of the canal.

(*g*) A strip of the water in the shut-off IJ, 100 meters wide, west of the boundary dike to Schellingwoude, from the mouth of the Merwede Canal to the Oranje Locks.

(*h*) the Oranje Locks.

(*i*) The fairway in the open IJ outside the Oranje Locks, viz, a strip of water to the length of 4,300 meters and of a breadth of 315 meters, measured from the edge of the bordering dam, together with that dam.

The parts to which these regulations apply are indicated on the subjoined map by a blue color.

Art. 2. These regulations shall be printed and be generally obtainable.

An English, a German, and a French translation shall also be printed and be generally obtainable.

Art. 3. The minimum depth in the outer port, the outer canal, and the outer canal leading to the large locks at Ijmuiden shall, in accordance with the tide, be indicated by signals at the mouth of the outer canal.

In accordance with the tide, the depth in decimeters shall be signaled in ciphers at the large locks at which ships may be able to pass through, provided the signals permit of entrance. Skippers of vessels of a draft exceeding 80 decimeters, on their approach to the locks shall assure themselves of the exact draft of their vessel, and shall not be allowed to pass the lock should that draft exceed that indicated by the depth signal at the lock, even though the signals for entrance to the sluice permit entrance thereto.

[1] Plate 10, Report on Panama Canal Traffic and Tolls.

Only such vessels shall be admitted to the canal as, wherever measured, have no greater draft in regard to the main canal than 9.20 meters, the height of the water in the canal being 0.50 meters or thereabouts, N. A. P. (Amsterdam gauge), and proportionately more or less as the height of the water in the canal is higher or lower than the height mentioned. In regard to the side canal to Zaandam (side canal G), 8 meters, the height of water in the canal being 0.50 meters or thereabouts, N. A. P., and proportionately more or less as the height of the water in the canal is higher or lower than the height mentioned; in regard to the inner canal leading to the North Sea gates, 7.10 meters, the height of the water in the canal being 0.56 meters or thereabouts, N. A. P., and proportionately more or less as the height of the water in the canal is higher or lower than the height mentioned; in regard to the fairway east of Amsterdam and above the Oranje Locks, 3.50 meters; in regard to the side canals to Spaarndam, to Nauerna, and to Halfweg, to a distance of 1,100 meters north of the lock, 3 meters at that point; in regard to the side canal to Nieuwendam, 2.80 meters; in regard to the side canal to Westzaan, 2.20 meters, with the exception of the mooring place for sea vessels in this channel, where, according to the actual depth of water, sea vessels are admitted with a draft of from 5.50 meters at the beginning to a depth of 3 meters at the end; in the side canal to Oostzaan, 2 meters; in the side canal to Beverwijk, 2 meters; in the side canal to the Molen sluis (mill sluice) part of the side canal to Halfweg, 1.30 meters.

The drafts given in regard to the main canal apply in respect to the height of water to the west of Amsterdam, as read on the gauges at the North Sea locks; to the east of Amsterdam in respect to the height of water, as read on the gauges there or at the Oranje Lock.

As an indication of the draft of vessels entering the canal at Ijmuiden, their draft in the outer port or the outer canal shall be taken, increased by 1 decimeter.

The draft given in regard to the side canals shall all apply at a height of water of 0.50 meter or thereabouts, N. A. P., and higher, as read on the gauges at Amsterdam or at the Oranje Locks.

The maximum breadth of the vessels shall be: For the North Sea Locks at Ijmuiden, 24 meters; for the Oranje Locks, 17.75 meters; for the eastern side canal to Spaarndam (side canal C), on passing through the western passage of the revolving bridge across the mouth of the side canal, 11.75 meters; for the eastern passage of the revolving bridge across the mouth of the side canal C, 9.50 meters.

The maximum length of the vessels shall be: For the North Sea Locks at Ijmuiden, 220 meters; for the Oranje Locks, 90 meters.

The western side canal to Spaarndam (side canal B) may only be entered by vessels with their mast lowered, which are not more than 1.50 meters above the level of the water.

Under special circumstances the harbor master is empowered to detain ships, should he deem it necessary in the interest of the navigation.

ART. 4. Of the side canal to Halfweg (side canal F), the northern part thereof as far as 2,500 meters, south of the axis of the main canal is fitted up as a mooring place for fishing torpedoes.

Whenever the side canal is being used as such, the navigation may temporarily be suspended and captains, desirous of using the side canal, will have to act according to the directions of the marine authorities on the spot, and if necessary remove their vessels at their orders.

ART. 5. Ships coming from the sea and sailing or moored in the outer port shall, whenever the harbor master may deem necessary, get his orders by means of signals according to the general international signal book, those signals to be hoisted on the semaphore post at the mouth of the outer canal.

In deviation from article 13 of the general regulations, the there indicated signals, notifying that entrance to the harbor is blocked, shall not be hoisted in front of the outer harbor in the North Sea on one of the pierheads, but on the aforementioned semaphore post. As long as those signals are hoisted, no depth, current, or other signals shall be shown on the semaphore post.

ART. 6. Captains, obliged or wishing to stay with their vessels in the outer canal or the outer canals leading to North Sea gates, must give notice thereof at the harbor master's office and subsequently proceed to their mooring place, which shall be assigned them by the harbor master or his substitute.

ART. 7. Supplementary to article 77 of the general regulations, it is forbidden to anchor in the walled-in fairway of the outer port at Ijmuiden, and in the fairway in the open IJ, outside the Oranje locks, except with the permission of the lock keeper of the gates.

It is also forbidden to anchor in the canal within 25 meters of the places near which there is a warning that there is a cable across the canal at that spot, as also within 50 meters of the ferry crossing.

ART. 8. Article 7 of the general regulations as far as the outer canal and the main canal are concerned, does not apply to ships towed abroad, measuring together no more than 10 meters, that are properly attached fore and aft, and in the judgment of the harbor master are sufficiently manned to remove, with a view to the state of the weather, all obstacles to navigation and all causes that might lead to collision and damage.

ART. 9. Article 8, second clause, of the general regulations, is to read for this canal as follows:

Vessels of 6 meters or greater draft shall, moreover, carry flag P of the international signal book at the foremast and at night three red lights hoisted one below the other at a distance from each other of not less than 0.50 meters.

Moored vessels shall lower these signals half way.

In the case of vessels of less than 6 meters draft the carrying of these signals is forbidden.

Sea vessels shall constantly carry at night the white stern light, mentioned in article 10 of the provisions for the prevention of collisions at sea, decreed by royal order of the 24th of April, 1897 (Official Gazette No. 107).

ART. 10. Article 65 of the general regulations does not apply to vessels in the outer port.

All sailing vessels under sail shall, on the approach of a sea vessel under steam or in tow, leave the fairway clear, that is to say, give way or, if necessary, lower sail. Article 26, second clause, of the regulations for the prevention of collisions or drifting in public waters in the kingdom, does not apply to sea vessels under steam or the tugs having sea vessels in tow.

ART. 11. Whenever, in the main canal, in the case of ice, a narrow channel has been made, it is forbidden to navigate outside this channel, except with the special authorization of the harbor master or his substitute.

ART. 12. All vessels on passing steam dredging vessels shall keep to the shore which, during the day, is indicated by a blue flag, at night by two green lights hoisted one above the other. Moreover, on approaching a steam dredging vessel a warning shall be given from the ship by the ship's bell, the steam whistle, or the foghorn, or even by shouting.

ART. 13. Vessels shall not be allowed to drift or, generally, stop at or near the ferry crossing.

On approaching the steam ferry at Velsen, captains shall, on reaching the distance signal poles at about 600 meters on either side thereof, give warning of their approach by a prolonged blast on the steam whistle or the foghorn, or by ringing the ship's bell.

ART. 14. Sea vessels proceeding in the same direction may not pass each other.

In addition to the case of sea vessels mutually, the passing of any vessels proceeding in the same direction is only allowed, when the outlook ahead is clear, or approaching vessels are at such a distance that the overtaking vessel is certain that the passing of the overtaken vessel will be effected before the first approaching vessel is met.

ART. 15. In deviation from the provision of article 14 of the general regulations, three red lights at an equal height or the sluicing flag at half mast shall be hoisted in due time, if possible one hour prior to the commencement of the opening of the floodgates. On opening the floodgates the lights shall be placed triangularly or the flag raised to the top.

After having opened the flood gates of the North Sea Locks the sluicing flag shall be exhibited at the semaphore post at Ijmuiden, at the steam ferry at Velsen, and at the ferry east of the Hembrug.

Should more than one flood gate be opened, the signals prescribed for each gate opened shall be hoisted separately and at the semaphore post at Ijmuiden the floodgate signal shall be doubled.

Vessels of a draft of more than 65 decimeters coming from sea may request that the outlet of water through the North Sea gates be tempered or stopped by hoisting flag N of the international signal book during the day and by showing a red light at night; in the case of a steam vessel to be hoisted above the top light.

By entirely or almost entirely or partially lowering the sluicing signal at the semaphore post a reply shall be given as to whether the request is granted or not.

After the hoisting of the sluicing signals at the North Sea Locks it is forbidden, without the permission of the sluice master, to approach the opened locks nearer than the place marked by a board put up at a distance of 300 meters from the said locks.

Whenever water is being let in through the Oranje Locks warning thereof shall be given by a white flag bearing in black letters the word "inlaten" during the day and at night by three red lights placed in the shape of an equilateral triangle with the point downward.

After the hoisting of the sluicing signal or the water inlet signal the lock or locks at which those signals are exhibited shall be carefully avoided, and if necessary the vessels shall promptly cast anchor.

ART. 16. As soon as the outer water has reached a height of 1.50 meters or thereabouts, N. A. P., the large lock at Ijmuiden shall no longer be opened. The middle and little lock there, as well as the Oranje Locks, shall not be opened as long as the outer water has reached a height of 1.25 meters or thereabouts, N. A. P.

The large lock and the small lock at Ijmuiden shall not be opened whenever more than 1.25 meters of water has to be kept back by the ebb gates.

The middle lock at Ijmuiden and the Oranje Lock shall not be opened whenever more than 1 meter of water has to be kept back by the ebb gates.

ART. 17. If on the North Sea Lock the red cylinder covered by a half ball, mentioned in article 15 of the general police regulations, is hoisted by day and by night the red light is displayed, the captain shall stop his vessel at 100 meters distance from the lock.

The inlet lock shall be indicated by the covered cylinder above mentioned by day and by night by a green light on either side.

Whenever over the Oranje Locks the red signal board mentioned in article 15 of the general regulations is exhibited by day and the red light at night the captain must stop his vessel at a distance of 100 meters from the lock. The lock to be passed shall be indicated by a white board during the day on either side and at night by a green light on either side.

Whenever a white flag with a white circular space in the middle is hoisted over the Oranje Locks the approaching vessel shall immediately cast anchor. At night instead of the flag two red lights shall be placed the one above the other.

Whenever the said signals are shown at the North Sea Locks any approaching vessel shall not pass the board put up at a distance of 300 meters, but shall be safely moored, in doing which, except for a counter order from or in the name of the harbor master, the first arrival shall moor closest to the lock, and so on in succession.

In foggy weather at the outermost lighthouse at Ijmuiden signals shall be given with a foghorn, and at the Oranje Locks a bell shall be sounded as guide for the vessels navigating in the neighborhood.

ART. 18. The rule indicated in article 16 of the general regulations shall be given by the harbor master or the sluice master at the North Sea Locks.

On approaching the North Sea locks, when no other signal is given, all vessels of 100 meters in length and upward and of a draft of 6 meters or more shall proceed toward the large lock and the rest toward the other North Sea locks.

In case of deviation from this general rule notice hereof shall be given on the signal poles situated at the extremities of the land projection which separates the large locks from the North Sea locks.

During the day this signal shall be given by a red signal arm on these poles placed horizontally and pointing toward the sluice that is to be passed.

At night the signal shall be given by a flickering light on the signal pole, and that in the following manner:

If the light on the projection flickers red within or to the east of the sluices, all outgoing vessels shall proceed toward the large lock; if it flickers green, all outgoing vessels must go toward the old North Sea locks.

If the light on the projection flickers green outside or to the west of the sluices, all incoming vessels must proceed toward the large lock; if it flickers red, all incoming vessels must go toward the old North Sea locks.

In respect of night signals the rule shall be as follows, applying to vessels passing each other, namely, color to color.

If no signals are given and therefore the general rule is to be followed, the signal arm hangs vertically and at night the white lights shall flicker.

ART. 19. In passing the drawbridge across the mouth of the eastern side canal to Spaarndam (side channel C) all vessels and flat-bottom boats must pass the opening on the starboard side unless the bridgeman allows or orders them to make use of the other opening.

The day signal, mentioned in article 15, second clause of the general regulations, shall be given at this bridge by means of a red ball.

ART. 20. Article 17, first clause of the general regulations, shall read for this canal as follows:

> The passing shall be regulated by the acting sluice master, in which attention, as far as possible, shall be given to the order of arrival.

Captains shall, on receipt of the order thereto from the officiating sluice master, leave the lock with their vessels immediately after passing through. If at Ijmuiden, in that case the clearing of the vessel, whether in or out, is not completed, the captain shall moor the vessel in or outside the sluice at the spot given him by the harbor master or the officiating sluice master until the clearing has been effected.

ART. 21. In deviation from article 18 of the general regulations the order in which ships are to be let through the North Sea locks shall be fixed as follows:

(1) Vessels carrying a pennant.

(2) Government vessels and vessels serving for the conveyance of the waterstaat officials or canal servants on duty.

(3) Steam vessels sailing in regular service for the ports on the Dutch, Belgium, or British coast, for French ports north of Brest, for the ports of Norway, Sweden, and Denmark, or for those on the Baltic or the Danish ports on the North Sea.

(4) Steamers carrying Dutch mails or chiefly accommodated for passengers in regular service for ports out of Europe.

(5) Vessels loaded with fresh fish.

Vessels loaded with gunpowder, fireworks, guncotton, nitroglycerine, quicklime, or other explosives or easily inflammable goods shall be let through before all other vessels as far as possible and always separately.

Steamers sailing in regular service for ports in Europe, not mentioned sub (3) and steamers not carrying Dutch mails and not accommodated chiefly for passengers, but sailing in regular service for ports out of Europe, may be granted the same rights, respectively, as the steamers mentioned subs (3) and (4) by a revocable order of the minister on a petition stating reasons for the request.

The time-tables of vessels sailing in regular service must be made known to the harbor master by special notice of the manager of the service and to the public by advertising the time-tables in at least two Dutch newspapers. Deviations in the days of departure from Amsterdam or other places on the North Sea Canal or any of the side canals should at least one week in advance be made known to the harbor master and to the public in the same way.

Whenever such notice has not been made or any deviation in the dates of departures takes place, the right of precedence in being let through the locks is forfeited.

ART. 22. Captains shall see that on entering the locks the necessary mooring cables are ready; moreover, captains of sea vessels shall provide that the necessary staff of men be on the spot ashore to take hold of those cables and make them fast.

Captains of sea vessels before leaving the lock shall give to the officiating sluice master a written statement, or see that such be done, of the length, breadth, draft, net tonnage, place of origin, and destination of the vessel, as well as the name and residence of the captain.

In case of noncompliance with these orders the sluice master may refuse to allow the ship to pass.

ART. 23. Sea vessels may not moor to State wharfs and load and unload at such place except with the permission of the harbor master.

In loading or discharging sand, ballast, grain, coal, and similar cargoes the skippers shall spread a sail or cloth from the shore to the ship's deck or from the one ship to the other.

From one hour after sunset till one hour before sunrise no sand, ballast, or cargo shall be loaded or discharged without a written license of the harbor master, observing the directions of the said harbor master and under such superintendence as shall be ordered by him and kept up at the expense of the skippers.

The removal of sand, mud, or other goods by means of mud boats, except with a written license from the harbor master, observing the directions of the said harbor master and under such superintendence as shall be ordered by him and kept up at the expense of the skipper, is prohibited.

Loaded mud boats not provided with such a license shall not be let through the locks at Ijmuiden or the Oranje locks.

In the discharging of mud on or across the quay care shall be taken that no slime or other solid matter be flung into the water in the canal or permitted to float back into the adjoining waters, failing which the discharging may be stopped by the harbor master or the waterstaat official.

The provisions of the two preceding clauses of this article do not apply to the execution of Government waterworks in or along the canal.

ART. 24. The second clause of article 23 of the general regulations is not enforced for this canal, the first clause being applied only to ships of 10 meters and more.

ART. 25. Supplementary to article 10 of the general regulations the towing of vessels which are overladen or not properly laden and which, in the opinion of the harbor master or the waterstaat official, threaten to be swamped or sink, is forbidden.

The skipper of the vessel towing such vessel shall stop at the first call from the harbor master or the waterstaat official and convey the said vessel to the place indicated by him.

ART. 26. Vessels loaded with gunpowder, fireworks, guncotton, nitroglycerine, quicklime, or other explosive or easily inflammable goods or similar goods are not allowed, except in pressing need, as the harbor master shall decide, during the night to lie in or take up their berths except in the parts of the main canal between Buitenhuizen and the western side canal to Spaarndam (side canal B) or at such other places as the minister shall indicate. These vessels shall remain moored to the upper shore of said length of canal.

ART. 27. Sea vessels loaded with gunpowder, other explosives, or inflammable goods, so long as they are in the waters mentioned in article 1, in deviation from article 48 of the provisions established by royal order of the 15th of October, 1885 (Official Gazette No. 87), last revised by royal order of the 7th of March, 1907 (Official Gazette No. 60), shall carry flag B of the international signal book at the top by day and at night two red lights at a distance from each other of at least 1 meter equally high and at least 6 meters from the deck.

These red lights, hoisted at least 3 meters above the deck, shall be shown at night on river vessels loaded with gunpowder, other explosives, or easily inflammable goods.

When the weather is foggy or hazy, no vessel carrying gunpowder, other explosives, or easily inflammable goods is allowed to proceed through the waters mentioned in article 1 unless her colors or lights may easily be distinguished at a distance of at least 500 meters.

ART. 28. On board of every sea vessel on the canal or in the harbors the skipper shall cause a regular watch to be kept on deck at night.

Fishing vessels are exempted from the above.

ART. 29. On board of every vessel according to the judgment of the harbormaster the necessary number of hands and contrivances must always be found, to prevent obstruction of navigation and the causing of damage to other ships.

ART. 30. In case of a fire breaking out on board any vessel in any of the harbors or in the canals, the skippers of other vessels, not threatened by the fire shall, at the demand of the harbormaster or other canal officials, immediately lend half the number of their crews present to assist in controlling the fire and to do everything that the harbormaster or other canal officials may judge requisite for the prevention of further accidents.

ART. 31. The maximum of speed at which steam vessels are allowed to proceed is per minute:

In the main canals: For steam vessels having a draft of 6 meters and more, 175 meters; if less than 6 meters and more than 4 meters, 200 meters; of 4 meters and less, 250 meters.

In the side canals: For steam vessels having a draft exceeding 2 meters, 150 meters; not exceeding 2 meters, 200 meters; not exceeding 1.50 meters, 250 meters.

Except in the cases mentioned in articles 30 and 68 of the general regulations the speed in passing ferries shall be reduced as much as is necessray to prevent damage from the wash or from suction.

ART. 32. The greatest speed at which a vessel may be towed shall not exceed 150 meters a minute.

From one hour after sunset to one hour before sunrise this speed in any of the side canals shall not exceed 100 meters a minute.

ART. 33. Not more than two sea vessels at a time shall be towed by the same steam tug.

Fishing vessels, however, are excepted.

The total tonnage of the vessels in tow may not exceed 2,000 cubic meters (700 registered tons).

If the tonnage of a sea vessel exceeds 1,400 cubic meters (500 registered tons) it may not be towed together with another sea vessel by the same steam tug.

The number of nonseagoing vessels or lighters or of fishing vessels towed at a time may not exceed ten, in which a vessel of 150 cubic meters and more tonnage in the train shall be counted as two vessels.

In the outer canal and the main canal the entire length of the train, measured from the stern of the tug to the stern of the last boat tugged, shall not exceed 150 meters.

The chief engineer is empowered to limit the number of boats to be towed at a time.

ART. 34. The maximum length of the raft shall be 100 meters, provided they be so constructed that they can be divided into parts of no more than 50 meters in length.

The maximum breadth allowed is 7.50 meters; maximum draft, 1 meter.

The rate at which they are permitted to proceed is not to exceed 80 meters per minute.

ART. 35. Any steam tug, towing a raft, on meeting an approaching sailing or sea steamer or sea vessels and convoys of more than three vessels in tow, is bound to stop, and, if necessary, to moor to the shore with the raft, until the vessel or the convoy shall have passed.

The same shall be done whenever a similar vessel or convoy in tow overtakes the towed raft and wishes to pass it.

ART. 36. At night the raft shall lie at the side of the canal, where there is no towing path, or on the side where the least towing on the towing path takes place.

ART. 37. Supplementary to the provision in article 76 of the general regulations, vessels or rafts lying-to shall in no case be moored to poles to which electric wires are attached.

ART. 38. The provisions laid down in these regulations and the general regulations for steamers, shall, as far as this canal is concerned, apply to motor vessels, inclusive of all vessels which are propelled by means of any mechanism in the vessel.

ART. 39. Supplementary to article 91, second clause, of the general regulations, it is provided that the written report respecting damage done to the canal works shall be made known by sending a copy thereof to:

(*a*) In the case of damage to the works under the control of the Marine Department, to the director and commander of the marine service at Amsterdam.

(*b*) For damage to the works under the control of the Department of War, to the interested nearest officer of the engineers.

(*c*) For damage to the works under the control of the Finance Department, to the interested inspector of customs and excise.

(*d*) For damage to the works of special boards or persons, to those boards or persons.

ART. 40. The penalties for infringement of these special regulations, when not otherwise provided for by statute or by the general regulations, are as follows:

(*a*) For a breach of articles 4, 6, 7, 10 second clause, 13, 26, 27, 30, and 33, first, third, fourth, fifth, and sixth clause, imprisonment for a period not exceeding 30 days or a fine not exceeding 150 guilders.

(*b*) For a breach of articles 3 second clause, 11, 12, 14, 15 sixth and eighth clause, 17 first, second, third, and fourth clause, 28, 29, 31 last clause, 32, 35, 36, and 37, a fine not exceeding 100 guilders.

(*c*) For a breach of article 9 last clause but one and last clause, 19 first clause, 20 second clause, 23 first, second, third, and fourth clause, and 25. a fine not exceeding 25 guilders.

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